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QUARTZ CRYSTAL RELIABILITY STUDIES

REPORT NUMBER 2

CONTRACT DA 36-039 SC-89199

ORDER NUMBER 1048-PM-62-93-93 (4805)

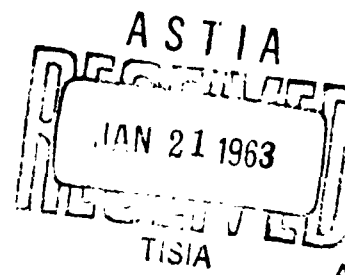
SECOND QUARTERLY PROGRESS REPORT

5 JULY 1962 to 5 OCTOBER 1962

U.S. ARMY SIGNAL RESEARCH AND DEVELOPMENT

LABORATORY, FORT MONMOUTH, NEW JERSEY

INLAND TESTING LABORATORIES DIVISION
COOK ELECTRIC COMPANY
1482 Stanley Avenue
Dayton 4, Ohio



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SIGNAL CORPS TECHNICAL REQUIREMENTS

NUMBER SCL-7003/84, 5 SEPTEMBER 1961

DEPARTMENT OF THE ARMY PROJECT NUMBER 991500401

SECOND QUARTERLY REPORT, 5 JULY 1962 to 5 OCTOBER 1962

The objectives of this study are:

1. - The determination of the causes of failure in quartz crystal units.
2. - The formulation of accelerated tests for the determination of "time to first failure", "meantime between failures", and "life time".
3. - The evaluation of such factors as elevated temperatures, and drive levels other than the recommended drive levels, in causing failure of quartz crystal units.
4. - The determination of a satisfactory definition of failure in terms of performance.

This report was prepared by Carleton E. Jones.

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Statement of Purpose

This study is an investigation of factors that produce failures of quartz crystal units. The work is divided into five phases, which are not necessarily to be performed in chronological order.

Phase I: The contractor will procure, from industry, military quartz crystal units in the types and quantities specified in Signal Corps Technical Requirement SCL-7003/84. Each of these quartz crystal units will be subjected to all preproduction tests required by Specification MIL-C-3098C, and such other tests as may be required to establish that the crystal units are of a quality suitable for the study. Any crystal units which fail these tests will be eliminated from further study.

Phase II: The crystal units that conform to all specification requirements during Phase I testing will be subjected to tests as listed below.

- (a) All crystal units that are normally operated under controlled temperature conditions will be stored at their specified operating temperatures.
- (b) One-fourth of the crystal units that are normally operated under non-controlled temperature conditions will be stored at plus 85 degrees centigrade. The remaining three-fourths of these units will be operated in oscillators at room ambient, one-third of them at 25 percent of rated drive level, one-third at 100 percent of rated drive level, and one-third at 500 percent of rated drive level.

(c) Measurements of series resonant frequency and resistance will be made at the end of each of the following periods of time after the start of the test: 24 hours, 125 hours, 225 hours, 500 hours, 1000 hours, 2000 hours, and 5000 hours.

Phase III: The frequency versus temperature characteristics of the crystal units will be redetermined.

Phase IV: Those crystal units which still meet the requirements of MIL-C-3098C at the end of Phase III will be divided into two lots, one of which will be subjected to shock tests, the other to vibration tests. The frequency and effective resistance of the crystal units will then be redetermined.

Phase V: A final report will be prepared, analyzing the data generated in Phases I through IV with regard to: (a) determination of causes of failure; (b) the formulation of tests to determine "time to first failure", "mean time between failures", and "life time"; (c) the effects of elevated temperatures, and high and low drive levels in inducing failure; (d) a workable definition of failure in terms of crystal performance; and (e) determination of a reliability figure for quartz crystals.

Abstract

Phase I (the preproduction testing of the crystal units) is progressing well. Two hundred ten of the six hundred crystal samples involved in this study have completed Phase I and are now in Phase II testing.

No problems of any significance have been encountered in performing either Phase I or Phase II tests. Slow delivery of the crystal units by the manufacturers continues to be the major element slowing progress with the study.

Publications, Lectures, Reports, and Conferences

During the period covered by this Quarterly Report, there were no publications issued, and no lectures delivered.

The First Quarterly Report of this study was prepared and distributed, the distribution being accomplished during the week ending 6 September 1962. The third and fourth monthly reports were also submitted during this period.

A conference was held 10 July 1962, at the U.S. Army Research and Development Laboratories, Fort Monmouth, New Jersey. The Signal Corps representatives present were Mr. M. Bernstein, Mr. J. Stanley, and Mr. P. Mulvihill. The contractor was represented by Mr. W. Ingling, Mr. C. Jones, and Mr. E. Roeger. The discussions held were of a general nature, and led to some clarification of the statement of work. A consensus was reached regarding both the terminology and the methods to be employed in performing the work outlined in Signal Corps Technical Requirement SCL-7003/94.

FACTUAL DATA

During the period covered by this report several partial shipments of sample crystals were received. Manufacturer "A" has delivered all the CR-18A/U units, all the CR-32A/U units, and 79 of the 120 CR-67/U units that were ordered. No CR-74/U samples have been received from manufacturer "A".

Manufacturer "B" has delivered 90 of 120 CR-18A/U units ordered, as well as 103 of 120 CR-67/U units, 9 of 30 CR-32A/U units, and all 30 CR-74/U units. All the crystal units that have been received are now undergoing, or have completed, the preproduction tests.

The following identification system has been established for use during the study of the crystals supplied by manufacturer "A":

- Lot 1 - Type CR-18A/U, numbered from 1 through 30
- Lot 2 - Type CR-18A/U, numbered from 31 through 60
- Lot 3 - Type CR-18A/U, numbered from 61 through 90
- Lot 4 - Type CR-18A/U, numbered from 91 through 120
- Lot 5 - Type CR-67/U, numbered from 1 through 30
- Lot 6 - Type CR-67/U, numbered from A1 through A30
- Lot 7 - Type CR-67/U, numbered from T1 through T30
- Lot 8 - Type CR-67/U, numbered from L1 through L30
- Lot 9 - Type CR-32A/U, numbered from 1 through 30
- Lot 10 - Type CR-74/U, numbered from 1 through 30

A parallel identification system has been established for the crystals supplied by manufacturer "B".

- Lot 11 - Type CR-18A/U, numbered from 1 through 30
- Lot 12 - Type CR-18A/U, numbered from 31 through 60
- Lot 13 - Type CR-18A/U, numbered from 61 through 90
- Lot 14 - Type CR-18A/U, numbered from 91 through 120
- Lot 15 - Type CR-67/U, numbered from 1 through 30
- Lot 16 - Type CR-67/U, numbered from A1 through A30
- Lot 17 - Type CR-67/U, numbered from T1 through T30
- Lot 18 - Type CR-67/U, numbered from L1 through L30
- Lot 19 - Type CR-32A/U, numbered from 1 through 30
- Lot 20 - Type CR-74/U, numbered from 1 through 30

All crystal samples that have been received have been identified according to this system. As the balance of the crystal samples are received, they will also be marked in accordance with this system.

During this report period, Lots 1, 2, 3, 4, 5, 6, and 9 completed the preproduction tests of Specification MIL-C-30080, and entered Phase II testing. Lots 11, 12, 13, 15, 16, and 17 completed the preproduction tests through Low Temperature Storage. Lot 20 completed the preproduction tests through the initial measurement of series resonant frequency and effective resistance.

Descriptions of the manner of performing the visual and mechanical examinations, and the insulation resistance, shunt capacitance, overall frequency tolerance, and unwanted modes were included in the First Quarterly Report. The remainder of the preproduction tests were performed as described below:

(a) Reduced Drive Level

A fixed resistor, whose resistance is equal to the maximum allowable resistance for the crystal under test, is connected to the crystal socket of the test set. The screen voltage control of the test set is then adjusted to provide a grid-current meter deflection 2.5 microamperes greater than the non-oscillating reading of the grid-current meter. The meter shunt control is at its maximum clockwise setting when this adjustment is made. The fixed resistor is then removed from the crystal socket of the test set, and the crystal under test is plugged into the socket. The grid-current meter shall show a deflection of at least 2.5 microamperes

from the non-oscillating grid-current meter indication. The crystal must also operate on frequency.

(b) Shock

The series resonant frequency and the effective resistance of the crystals are determined and recorded. The crystal units are then mounted in the specified shock machine and subjected to three impact shocks, each of 100 Gravity units intensity. One impact shock is applied along each of the three mutually perpendicular axes of each crystal unit. Following this, the series resonant frequency and the effective resistance of the crystals are again determined.

(c) Vibration

The series resonant frequency and the effective resistance of the crystal units are measured and recorded prior to vibration. The crystal units are then rigidly mounted on the table of a low-frequency vibration machine, so that the applied vibration will be as follows:

One-third of the units will have the vibratory motion applied parallel to the vertical axes of the crystal holders.

One-third of the units will have the vibratory motion applied parallel to the major horizontal axes of the crystal holders.

One-third of the units will have the vibratory motion applied parallel to the minor horizontal axes of the crystal holders.

The vibration consists of a simple harmonic motion having an amplitude of 0.03 inch (total excursion of 0.06 inch) and is applied continuously for a period of two hours. The frequency of the vibration is varied uniformly from 10 to 55 cycles per second, and returned to 10 cycles per second, once each minute. At the conclusion of the two hour period, the crystal units are removed from the low-frequency vibration machine, and then rigidly mounted to the table of a high-frequency vibration machine. The method of mounting and the orientation of the crystals units is the same as that for the low-frequency portion of the test.

The vibration consists of a simple harmonic motion having the necessary amplitude to provide the specified acceleration throughout the range of frequencies from 50 to 500 cycles per second. The frequency of vibration is automatically changed, at a logarithmic rate, from 50 to 500 and back to 50 cycles per second in a period of 12 minutes. The test is continued for a period of three hours.

At the conclusion of the three hour period, the crystal units are removed from the vibration machine, and the series resonant frequency and effective resistance are measured and recorded.

(d) Heat Cycling

Prior to the heat cycling test, the series resonant frequency and the effective resistance of the crystal units are measured and recorded. Following these measurements, the crystal units are

placed in a well-ventilated oven equipped with an automatic program controller and subjected to the following temperature cycle:

From an initial temperature of approximately plus 25 degrees Centigrade, the temperature within the oven is increased to approximately plus 100 degrees Centigrade. The rate of change of temperature is less than 2 degrees per minute. After the temperature reaches the 100 degree level, it is maintained at that level for a period of 30 minutes. At the conclusion of the 30 minute period, the temperature within the oven is decreased to approximately plus 25 degrees Centigrade, with the rate of temperature change less than 2 degrees per minute. This completes one cycle. The test is continued, without interruption, until three cycles have been completed. At the conclusion of the third cycle the series resonant frequency and the effective resistance of the crystal units are again measured and recorded.

(e) Low Temperature Storage

The series resonant frequency and effective resistance of the crystal units are measured and recorded. The crystal units are placed in a refrigerator, and starting from a temperature of approximately plus 25 degrees Centigrade, the temperature within the refrigerator is reduced to approximately minus 65 degrees Centigrade, and then maintained at that level for a period of one hour. At the end of the one hour period, the temperature is increased to approximately plus 25 degrees Centigrade, the rate of temperature change being less than 10 degrees per minute. This completes one

cycle. The test is continued, without interruption, until three cycles have been completed. At the conclusion of the third cycle, the crystal units are removed from the refrigerator, and their series resonant frequency and effective resistance are again measured and recorded.

(f) Leakage

The crystal units are immersed in a quantity of distilled water (containing a wetting agent) in an open glass container. The glass container is then placed in an altitude chamber, the chamber is closed and sealed, and the air pressure within the chamber is reduced to from 1.30 to 1.34 inches of mercury, absolute. This pressure is maintained for a period of five minute. During this period the crystal units are observed for leakage, as evidenced by a continuous formation of bubbles from the crystal units. At the conclusion of the five minute test period, the air pressure within the chamber is returned to room ambient, and the crystal units are removed from the test container and dried. The series resonant frequency and effective resistance of the crystal units are then measured and recorded. (This check of frequency and resistance is not required by Specification MIL-C- 3098C, but is performed because of the possibility that leakage might occur which is not visually detected.)

(g) Immersion

The crystal units are subjected to an immersion test, performed as follows: The crystal units are placed in a wire mesh

basket, and then completely immersed in a hot bath of fresh (tap) water. The temperature of the hot bath is kept between plus 65 and plus 70 degrees centigrade, and duration of the immersion is 15 minutes. The crystals are next lifted from the hot bath, and immediately immersed in a saturated solution of sodium chloride and water, the temperature of this bath being between plus 20 and plus 25 degrees Centigrade. The duration of this immersion is also 15 minutes. This procedure is performed twice, then the crystal units are rinsed in running tap water, dried, and the insulation resistance, series resonant frequency, and effective resistance are measured and recorded.

(h) Salt Spray (Corrosion)

The crystal units are subjected to the following salt spray test: The crystal units are suspended within the salt spray chamber by means of chemically inert cords. The chamber is then closed, the temperature within the chamber is increased to between plus 92 and plus 97 degrees Fahrenheit, and the specified salt spray is introduced into the chamber. The test is continued for a period of 48 hours, then the crystal units are removed from the test chamber, washed in running tap water, dried, and examined for evidence of corrosion. Finally, the series resonant frequency and the effective resistance are measured and recorded.

(i) Aging

One-half of the crystal units of each type are subjected to the aging test. The crystal units are mounted in an oven, in

crystal sockets, and leads are brought out of the oven to the test set. The oven is closed, and the temperature within it is increased to the temperature specified in MIL-C-3098C for aging the type of crystal being tested. The oven used is capable of maintaining any selected temperature (in its range) within plus or minus one-tenth of a degree centigrade. After 24 hours, and again after 96, 192, 264, 360, 432, 528, 600, 672, and 720 hours, the series resonant frequency of the crystal units was measured and recorded. The crystal units were not removed from the test chamber for the performance of these measurements.

(j) Moisture Resistance

The one-half of the crystal units of each type that are not subjected to the aging test are subjected to the moisture resistance test. The crystal units are dried, at a temperature of plus 50 degrees Centigrade, for a period of 24 hours. The crystal units are then transferred to the moisture resistance test chamber, where they are subjected to 10 continuous 24 hour cycles, as follows: During the first two and one-half hours, the temperature is raised from approximately plus 25 degrees Centigrade to plus 65 degrees Centigrade. This temperature is maintained for a period of three hours. The temperature falls to plus 25 degrees Centigrade during the next two and one-half hour period, and is again increased to plus 65 degrees Centigrade in the succeeding two and one-half hours. The temperature is maintained at that level for three hours, and is then gradually reduced to plus 25 degrees Centigrade during a period of two and one-half hours. The temper-

ature is maintained at plus 25 degrees Centigrade for a period of eight hours. This completes one cycle. Throughout the 24 hour cycle the relative humidity was maintained between 90 and 98 percent, with the following exception:

In five of the first nine cycles, during the eighteenth through the twenty-first hours of the 24 hour cycle, the temperature is reduced to minus 10 degrees Centigrade. The humidity is not controlled during this portion of the test.

At the conclusion of the 10 cycles, the crystals are removed from the test chamber, stored 24 hours at room conditions, and then the insulation resistance, series resonant frequency, and effective resistance are measured and recorded.

(k) Temperature Run for Extended Temperature Ranges

All crystal units designed for operation under noncontrolled temperature conditions are tested for conformance with the provisions of MIL-C-3098C through their specified temperature range.

The test equipment employed includes the following items:

- (1) Crystal Impedance Meter, TS-683/TSM
- (2) Vacuum tube Voltmeter, Hewlett-Packard Model 410-B
- (3) Standard frequency source, General Radio Type 1101-A piezo-electric oscillator and Type 1102-A multivibrator and power supply
- (4) Multi-band radio receiver, Hammarlund Model SP-600
- (5) Electronic Frequency Meter, Hewlett-Packard Model 500B
- (6) Temperature Recorder, Brown, Model 153 X 10V-K-26
- (7&8) Recording Meters, Esterline-Angus Model AW
- (9) Test slug, aluminum
- (10) Oven, and auto-transformer
- (11) Cold storage box
- (12) Platinum wire temperature sensor
- (13) Interpolation Oscillator, General Radio Type 1107-A

The setup and test procedure are as follows: All equipment is energized, and allowed to "warm-up" for a period of one hour. The drive adjustment of the crystal impedance meter is set near its low extreme, one of the test crystals is plugged into the crystal impedance meter, and the tuning control of the crystal impedance meter is adjusted to approximately the crystal frequency. The crystal impedance meter tuning and drive controls are adjusted until the grid-current meter indicates that the crystal is oscillating. The receiver is then tuned to the crystal frequency. The crystal is removed from the crystal impedance meter, the appropriate calibrating resistor is plugged into the crystal socket, and the vacuum tube voltmeter is used to adjust the drive level, as detailed in the instruction manual for the crystal impedance meter. The calibrating resistor is removed from the crystal impedance meter, a crystal plugged in, and the receiver tuning is adjusted for optimum reception of the signal from the crystal.

The output of either the 100 kilocycle or the 10 kilocycle multivibrator, depending on the nominal frequency of the crystal being tested, is coupled to the input of the receiver. The two signals are heterodyned in the receiver. The output of the receiver is an audio signal equal in frequency to the difference, in cycles per second, between the two R.F. signals.

The output of the interpolation oscillator is connected to the input of the electronic frequency meter, and the output from the frequency meter is connected to one of the recording meters.

Since the output of the electronic frequency meter is proportional to the input frequency, it is possible to cause the pen of the recorder to deflect in proportion to the frequency set up on the interpolation oscillator. The interpolation oscillator is set to the nominal frequency difference between the crystal and the standard harmonic signal. The recorder pen is adjusted to make this frequency fall at the center of the recorder chart, and the chart is advanced, leaving a mark at the nominal difference frequency point.

The output frequency of the interpolation oscillator is then adjusted, in turn, to the audio difference that marks the lower and upper frequency limits allowed the crystals, and the chart is marked at these two limits. This completes the calibration of the frequency test equipment. The interpolation oscillator is disconnected from the frequency meter, and the output from the receiver is connected to the input of the frequency meter. The pen of the recorder will trace out any changes in the difference between the two frequencies fed to the receiver, and since the stability of the signal from the standard oscillator is of a high order, any variations in the difference frequency can logically be attributed to a change in the frequency of the crystal being tested.

The crystal is removed from the socket of the crystal impedance meter, and a calibrating resistor, equal in resistance to the maximum effective resistance specified for the crystals being

tested, is plugged into the meter. The circuit to the grid-current meter of the crystal impedance meter is opened, and the meter current is fed into a D.C. amplifier. The output of the D.C. amplifier is connected to a recording meter. The D.C. amplifier gain and the mechanical adjustments of the recorder are set to give a convenient deflection on the recorder chart, this deflection is marked on the chart, and its ohmic equivalent is noted. A series of resistors having less resistance are then plugged into the test set, and the meter deflection caused by each is marked on the chart. Thus, when a crystal is plugged into the crystal impedance meter the position of the recorder pin gives, at any instant, an indication of the effective resistance of the crystal unit at that instant.

The temperature monitoring system functions as follows: The temperature sensor is a platinum resistance element, which is built into a crystal holder of the same size as the holder of the crystal to be tested. An aluminum slug, such as that illustrated in Figure 1, is used to hold the crystal and the temperature sensor. The leads of the temperature sensor are connected to the electronic temperature recorder, which is a resistance-bridge type. The chart drive mechanism of the temperature recorder is inoperative, and the chart is marked, at five degree Centigrade increments above and below zero degrees, with a narrow strip of conductive paint. A series circuit is established from a plate circuit relay (on an auxiliary chassis), through the pen of the recorder, the conductive

paint, and back to the relay. As the temperature changes and the recorder pen moves along the chart, the plate relay closes momentarily each time a five degree temperature increment is reached. The marker pens at the edges of the charts of the Esterline-Angus recorders are connected to a circuit which includes the contacts of the plate circuit relay. Thus, as each five degree increase or decrease in temperature occurs, the edge of the frequency and resistance charts are marked.

In testing a crystal through its operating temperature range, the procedure is as follows: A crystal is put into the well in one end of the aluminum test slug, and the temperature sensor is put into a corresponding well in the other end of the slug. The assembly is put into a cold storage box which contains finely divided dry ice, and the temperature of the assembly is reduced to a point a few degrees below the minimum specified operating temperature of the crystal.

A small oven, which was made by winding asbestos-covered resistance wire around a length of copper tubing whose inside diameter was a close fit over the test slug, is mounted on the front of the crystal impedance meter, so positioned that when the slug is inserted into the oven, the crystal pins are connected with the crystal socket in the impedance meter. The winding of the oven is connected to the output of an auto-transformer. The output voltage of the auto-transformer is pre-set to a level that will cause the temperature of the crystal to increase at the rate required for the test.

The slug is removed from the cold box, inserted in the oven, and the recorders and auto-transformer are energized. As the temperature reaches minus 55 degrees Centigrade, the marker pens of the recorders mark a temperature pip on the frequency and resistance charts. A continuous recording of the series resonant frequency and effective resistance of the crystal are produced through the operating temperature range, with temperature reference marks at 5 degree intervals along the edge of the chart. This procedure is repeated for each crystal of the same type and frequency.

For testing crystals of the temperature-controlled type, the cold box is eliminated, and the temperature of the crystal is raised from room temperature through its maximum operating temperature at a controlled rate. Temperature markers are put on the charts at five degree intervals throughout the specified operating temperature range.

PHASE II:

Performance of Phase II testing was begun on 12 September 1962. On that date, Lot 1 was placed in non-operating storage, at a temperature of plus 85 degrees Centigrade, in accordance with the provisions of Paragraph 3.2.2b, Signal Corps Technical Requirement SCL-7003/84. The oven in which the Lot 1 crystals are stored is fitted with racks which contain crystal sockets. The crystal sockets are connected, by coaxial cable, to bulkhead R.F. connectors (BNC series) which are mounted in a feed-through panel in the wall of the oven. Thus, the crystals

which are stored in this oven can be connected to the crystal impedance meter for test without removing them from the oven, as a short length of coaxial cable can be run from the BNC connector to the crystal socket in the crystal impedance meter.

On 13 September 1962, at the end of the first 24 hours of storage, Lot 1 was tested to determine the series resonant frequency and effective resistance of each of the crystal units, and the measured values of frequency and resistance were recorded. This procedure was repeated 125 hours, 225 hours, and 500 hours after initiation of the storage test. It will also be repeated 1000, 2000, 3000, 4000, and 5000 hours after initiation of the test.

Lot 2 also entered Phase II testing 12 September 1962. This lot of crystals is being operated in oscillators, at room ambient temperature. All Lot 2 crystal units are being driven at 25 percent of the rated drive level specified for 15 to 20 megacycle CR-18A/U crystals in specification MIL-C-3098C.

On 13 September 1962, at the end of the first 24 hours of storage, the Lot 2 crystals were removed from the oscillators, and placed in an oven which had been previously stabilized at a temperature of plus 30 degrees Centigrade. After a period of 24 hours at plus 30 degrees Centigrade, the series resonant frequency and effective resistance of each of the 30 crystals was determined and recorded. The crystals were then returned to operation in their respective oscillators. This entire procedure, including the 24 hour storage period, will be repeated at the same periods of time after initiation of the test as were listed above for Lot 1.

Lot 6 was put into storage, at plus 85 degrees Centigrade, on 13 September 1962. Lot 6 is being subjected to the same test procedures, performed at the same time intervals after initiation of the storage program, as were described above for Lot 1.

Lot 5 was put into operation, in oscillators, at room temperature, on 14 September 1962. The drive level for Lot 5 crystals was set to 100 percent of the drive specified for CR-67/U crystals. The crystals comprising Lot 5 are being subjected to the same test procedures, performed at the same time intervals after initiation of the storage program, as were described above for Lots 2, 3, and 4.

To the end of this report period, Lots 1, 2, 3, 4, 5, and 6 completed 500 hours of the storage tests. Lot 9 was put into the storage test at the close of the report period.

PHASES III, IV, and V:

The performance of these three Phases of the program cannot be initiated until completion of Phase II. As any Lot of crystals completes Phase II testing, that Lot will move into Phase III immediately. If no malfunctions of test equipment occur, Lot 1 should enter Phase III approximately 10 April 1963.

TEST DATA:

Test data, showing the series resonant frequency and the effective resistance of the various crystal units at stated times during preproduction and storage testing, is presented on pages 26 through 62 of this report. The information on each Lot of crystal is discussed and explained in the pages preceeding the data sheets.

TEST DATA

Pages 26 and 27 contain the test data on Lot 1 crystals. The nominal frequency of these crystal units is 19,990,700 cycles per second. The maximum effective resistance allowed for CR-18A/U crystals of this frequency is 20 ohms. The overall frequency tolerance is plus or minus 0.005 percent, the permitted frequency change due to shock or vibration is plus or minus 0.0005 percent, and the permitted resistance change due to shock vibration is plus or minus 10 percent. Thus, at any time in any preproduction test, the frequency of the crystals must be within plus or minus 1000 cycles per second of nominal frequency, and the resistance must not exceed 20 ohms, for the crystal to be in compliance with the requirements of specification MIL-C-3098C. The change in series resonant frequency due to shock or vibration must not exceed plus or minus 100 cycles per second, and the resistance must neither exceed 20 ohms, nor change more than 2 ohms due to shock or vibration. A review of the Lot 1 data reveals that each of the 30 units conformed to the specification requirements throughout the preproduction tests. The figures recorded on page 26 are the last five digits of the series resonant frequency, in cycles per second. Thus, the 90804 entered for sample number 1 in the column headed "Initial Frequency" indicates that the measured frequency of this crystal was 19,990,804 cycles per second. There are no entries in the column headed "After Mois. Res.", as aging, rather than moisture resistance, was performed on this lot of crystals. The figures on page 27 are the resistance, in ohms, of the samples, as measured after the various preproduction tests.

Pages 28, 29, 30, 31, 32, and 33 record the same information for

the crystals comprising Lots 2, 3, and 4. The sole failure to date among the crystals in Lots 1, 2, 3, and 4, was the failure of unit #120, in Lot 4, during vibration. The following four pages contain the equivalent data for Lots 5 and 6. The frequency tolerances for Lots 5 and 6 are plus or minus 1,250 cycles per second overall, and plus or minus 250 cycles change from shock or vibration. The maximum allowable equivalent resistance is 40 ohms. The permitted change in resistance from shock or vibration is plus or minus 4 ohms. Failures to date in these four lots include:

Lot 6: Units A3 and A13 stopped oscillating during the aging test.

Unit A27 would not oscillate when tested at the end of 225 hours of high-temperature storage.

Pages 38 and 39 contain data on the performance of the crystals in Lot 9. These type CR-32A/U crystal units have an overall frequency tolerance, in the range from plus 70 degrees Centigrade to plus 80 degrees Centigrade, of plus or minus 0.002 percent. The required stability within this temperature range is plus or minus 1000 cycles per second of the nominal frequency of 49,997,000 cycles per second (in this ten degree range) and in addition, cannot vary more than plus or minus 250 cycles per second at any point in that temperature range from any other frequency measured in that range. Thus, if a crystal is 500 cycles per second above the nominal frequency at a temperature of 75 degrees Centigrade, the frequency, throughout the temperature range from plus 70 to plus 80 degrees Centigrade, must be between 250 and 750 cycles per second above the nominal frequency of the crystal. The maximum acceptable

change in series resonant frequency from shock, vibration, or aging is also plus or minus 250 cycles per second. The maximum resistance is 40 ohms, the permitted change in resistance from shock or vibration is plus or minus 4 ohms. Failures to date in Lot 9 include:

Units 21 and 27 would not oscillate after vibration. The crystal holders were opened, and it was discovered that in each of these units the support wire for the crystal plate had broken from one of the pins in the base of the holder, at a point adjacent to the pin.

Unit 28 would not oscillate after low-temperature storage.

Units 15 and 19 would not oscillate after the salt spray test.

Lots 11, 12, 13, pages 40 through 45, are CR-18A/U samples from manufacturer "B". The same tolerances apply to this data as were listed for Lots 1, 2, 3, and 4. There have been no failures to date among the samples comprising Lots 11, 12, and 13. (The crystals for Lot 14 have not yet been received from the manufacturer.)

Lots 15, 16, and 17, pages 46 through 51, are CR-67/U samples from manufacturer "B", and are subject to the same tolerances as were listed above for Lots 5, 6, and 7. The sole failure to date is unit 25 of Lot 15. The failure was entirely mechanical, one of the leads of the crystal breaking off flush with the base of the crystal holder during the shock test. Electrically, this unit still performs satisfactorily. (The crystals which will make up Lot 18 have not been received from the manufacturer.)

Data on Lot 20 crystals is presented on pages 52 and 53. There have been no failures with these crystals.

The shunt capacitances of the crystals are recorded on data pages 54 through 62. Lot identifications and specification requirements are included on each data page. No crystal tested has failed to conform to the specification requirements for shunt capacitance.

For some Lots of crystals, the data presented in this report does not cover all tests that have been performed, as time limitations prevented reducing all the data taken to date to a format suitable for inclusion in this report.

| Sample Number | Initial Frequency | After Shock | After Vibration | After Low-Temp. | After Immersion | After Salt Spray | After Aging | After Mois. Res. | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Sample Number |
|---------------|-------------------|-------------|-----------------|-----------------|-----------------|------------------|-------------|------------------|------------------|-------------------|-------------------|-------------------|--------------------|---------------|
| 1 | 90805 | 90868 | 90791 | 90775 | 90873 | 90019 | 90969 | | 90916 | 90916 | 90926 | 90932 | 90932 | 1 |
| 2 | 90875 | 90920 | 91003 | 91238 | 91099 | 91450 | 91414 | | 91310 | 91338 | 91330 | 91326 | 91325 | 2 |
| 3 | 91549 | 91600 | 91621 | 91648 | 91421 | 91296 | 91207 | | 91245 | 91236 | 91236 | 91228 | 91226 | 3 |
| 4 | 90874 | 90965 | 91058 | 90892 | 90975 | 91108 | 91156 | | 91090 | 91083 | 91083 | 91066 | 91075 | 4 |
| 5 | 90101 | 90195 | 90278 | 90236 | 90207 | 90158 | 90188 | | 90148 | 90136 | 90142 | 90150 | 90153 | 5 |
| 6 | 90854 | 90929 | 91063 | 90936 | 90921 | 91065 | 91088 | | 91060 | 91058 | 91044 | 91040 | 91032 | 6 |
| 7 | 90131 | 90137 | 90178 | 90166 | 90127 | 90167 | 90198 | | 90208 | 90214 | 90222 | 90227 | 90224 | 7 |
| 8 | 90832 | 90875 | 91010 | 90814 | 90870 | 90837 | 90817 | | 90803 | 90786 | 90791 | 90797 | 90794 | 8 |
| 9 | 91165 | 91165 | 91209 | 91206 | 91160 | 91123 | 91107 | | 91088 | 91089 | 91078 | 91082 | 91085 | 9 |
| 10 | 91048 | 91061 | 91073 | 91055 | 91060 | 91047 | 91052 | | 91027 | 91020 | 91028 | 91017 | 91010 | 10 |
| 11 | 90983 | 90963 | 91004 | 91009 | 91064 | 91122 | 91116 | | 91100 | 91114 | 91108 | 91111 | 91113 | 11 |
| 12 | 90047 | 90062 | 90075 | 90055 | 90056 | 90078 | 90084 | | 90063 | 90065 | 90063 | 90062 | 90065 | 12 |
| 13 | 91525 | 91547 | 91564 | 91476 | 91500 | 91590 | 91650 | | 91613 | 91618 | 91620 | 91623 | 91625 | 13 |
| 14 | 91052 | 91058 | 91115 | 91122 | 91070 | 91038 | 91050 | | 91021 | 91014 | 91025 | 91020 | 91016 | 14 |
| 15 | 91391 | 91471 | 91581 | 91424 | 91476 | 91428 | 91461 | | 91382 | 91377 | 91375 | 91360 | 91356 | 15 |
| 16 | 91308 | 91368 | 91500 | 91315 | 91380 | 91425 | 91525 | | 91455 | 91455 | 91455 | 91455 | 91455 | 16 |
| 17 | 91229 | 91391 | 91422 | 91304 | 91371 | 91425 | 91574 | | 91521 | 91523 | 91524 | 91526 | 91530 | 17 |
| 18 | 91186 | 91163 | 91175 | 91192 | 91147 | 91147 | 91149 | | 91123 | 91120 | 91120 | 91121 | 91121 | 18 |
| 19 | 91265 | 91215 | 91364 | 91255 | 91230 | 91370 | 91409 | | 91380 | 91377 | 91375 | 91375 | 91373 | 19 |
| 20 | 91045 | 91072 | 91109 | 91194 | 91164 | 91135 | 91178 | | 91152 | 91129 | 91130 | 91130 | 91132 | 20 |
| 21 | 91058 | 91119 | 91154 | 91074 | 91115 | 91127 | 91138 | | 91068 | 91068 | 91070 | 91074 | 91075 | 21 |
| 22 | 91570 | 91606 | 91667 | 91528 | 91602 | 91703 | 91627 | | 91558 | 91555 | 91553 | 91550 | 91543 | 22 |
| 23 | 91531 | 91549 | 91579 | 91583 | 91632 | 91688 | 91595 | | 91531 | 91530 | 91530 | 91533 | 91533 | 23 |
| 24 | 91018 | 91077 | 91029 | 90980 | 91060 | 91024 | 91069 | | 91022 | 91023 | 91028 | 91033 | 91035 | 24 |
| 25 | 90461 | 90498 | 90423 | 90418 | 90460 | 90433 | 90458 | | 90443 | 90443 | 90444 | 90448 | 90449 | 25 |
| 26 | 90105 | 90161 | 90193 | 90103 | 90114 | 90130 | 90130 | | 90136 | 90137 | 90135 | 90130 | 90116 | 26 |
| 27 | 90755 | 90761 | 90845 | 90864 | 90768 | 90799 | 90853 | | 90801 | 90805 | 90817 | 90827 | 90833 | 27 |
| 28 | 90988 | 90953 | 90976 | 90965 | 90949 | 90953 | 90916 | | 90888 | 90880 | 90883 | 90897 | 90908 | 28 |
| 29 | 90224 | 90222 | 90308 | 90342 | 90324 | 90372 | 90381 | | 90345 | 90344 | 90355 | 90362 | 90365 | 29 |
| 30 | 90613 | 90584 | 90562 | 90504 | 90514 | 90554 | 90586 | | 90549 | 90553 | 90553 | 90553 | 90553 | 30 |

Lot 1, Series Resonant Frequency

| Sample Number | Initial Resistance | After Shock | After Vibration | After Low-Temp. | After Immersion | After Salt Spray | After Mois. Res. | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Storage 2000 hours | Storage 3000 hours | Storage 4000 hours | Storage 5000 hours | Sample Number |
|---------------|--------------------|-------------|-----------------|-----------------|-----------------|------------------|------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------|
| 1 | 4.0 | 4.5 | 5.0 | 4.5 | 4.5 | 6.0 | | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | | | | | | 1 |
| 2 | 4.5 | 5.0 | 5.0 | 5.0 | 5.5 | 7.0 | | 6.5 | 6.5 | 7.0 | 6.5 | 6.5 | | | | | | 2 |
| 3 | 10.0 | 12.0 | 12.0 | 10.0 | 10.0 | 12.5 | | 14.0 | 13.0 | 14.0 | 12.0 | 11.0 | | | | | | 3 |
| 4 | 8.0 | 6.5 | 8.5 | 8.0 | 8.5 | 10.5 | | 11.0 | 11.5 | 14.0 | 13.0 | 14.0 | | | | | | 4 |
| 5 | 7.0 | 5.5 | 4.5 | 5.5 | 6.0 | 7.0 | | 9.0 | 11.0 | 9.0 | 8.5 | 10.0 | | | | | | 5 |
| 6 | 4.5 | 5.0 | 4.0 | 5.5 | 6.0 | 6.0 | | 7.5 | 9.0 | 11.0 | 12.0 | 14.0 | | | | | | 6 |
| 7 | 8.0 | 6.5 | 7.0 | 7.0 | 6.0 | 7.0 | | 8.5 | 10.0 | 12.0 | 14.5 | 18.0 | | | | | | 7 |
| 8 | 7.0 | 5.0 | 4.5 | 5.0 | 6.0 | 7.0 | | 8.0 | 10.5 | 11.0 | 13.0 | 14.0 | | | | | | 8 |
| 9 | 7.0 | 5.0 | 4.5 | 5.5 | 5.0 | 6.5 | | 7.5 | 8.5 | 9.5 | 10.0 | 9.5 | | | | | | 9 |
| 10 | 8.0 | 6.5 | 6.0 | 5.5 | 7.0 | 6.5 | | 7.0 | 8.5 | 8.5 | 8.5 | 9.0 | | | | | | 10 |
| 11 | 9.5 | 7.5 | 7.0 | 7.0 | 8.5 | 7.0 | | 9.0 | 11.0 | 12.5 | 10.0 | 10.0 | | | | | | 11 |
| 12 | 9.5 | 8.0 | 6.5 | 6.5 | 6.0 | 6.0 | | 8.0 | 9.5 | 10.5 | 13.5 | 14.0 | | | | | | 12 |
| 13 | 7.0 | 5.0 | 4.5 | 5.0 | 5.5 | 5.0 | | 6.5 | 9.0 | 10.0 | 14.0 | 12.5 | | | | | | 13 |
| 14 | 8.0 | 6.5 | 6.5 | 6.5 | 5.5 | 6.5 | | 6.5 | 7.0 | 10.5 | 12.0 | 12.0 | | | | | | 14 |
| 15 | 4.5 | 4.5 | 4.5 | 5.0 | 4.5 | 6.0 | | 7.0 | 7.5 | 8.0 | 8.0 | 8.5 | | | | | | 15 |
| 16 | 9.5 | 7.5 | 6.5 | 7.0 | 8.0 | 9.5 | | 9.5 | 8.0 | 8.0 | 8.5 | 8.0 | | | | | | 16 |
| 17 | 20.0 | 18.5 | 19.0 | 17.0 | 17.0 | 15.5 | | 16.0 | 13.0 | 13.0 | 12.0 | 10.5 | | | | | | 17 |
| 18 | 8.0 | 6.0 | 6.0 | 6.0 | 7.0 | 8.0 | | 9.5 | 10.0 | 7.5 | 9.0 | 10.5 | | | | | | 18 |
| 19 | 16.0 | 14.0 | 12.0 | 11.0 | 13.0 | 11.5 | | 11.5 | 11.5 | 10.5 | 10.5 | 10.5 | | | | | | 19 |
| 20 | 9.5 | 7.5 | 6.5 | 6.5 | 6.0 | 8.0 | | 9.0 | 10.5 | 11.0 | 12.0 | 11.0 | | | | | | 20 |
| 21 | 9.5 | 7.5 | 6.5 | 6.5 | 6.5 | 8.5 | | 9.5 | 10.0 | 10.5 | 8.5 | 8.5 | | | | | | 21 |
| 22 | 8.0 | 6.5 | 8.5 | 10.0 | 9.5 | 11.5 | | 11.5 | 12.5 | 14.0 | 10.0 | 11.0 | | | | | | 22 |
| 23 | 16.0 | 14.0 | 13.5 | 15.5 | 17.0 | 16.0 | | 15.5 | 14.0 | 13.0 | 11.5 | 10.0 | | | | | | 23 |
| 24 | 13.0 | 11.5 | 13.0 | 14.0 | 15.0 | 14.5 | | 14.5 | 13.5 | 13.5 | 13.0 | 12.5 | | | | | | 24 |
| 25 | 4.5 | 4.5 | 4.5 | 6.0 | 6.0 | 7.0 | | 7.5 | 7.0 | 7.5 | 7.5 | 6.5 | | | | | | 25 |
| 26 | 4.0 | 4.5 | 4.0 | 4.0 | 4.5 | 5.0 | | 6.5 | 8.0 | 9.0 | 9.5 | 8.5 | | | | | | 26 |
| 27 | 9.5 | 7.5 | 8.0 | 9.0 | 7.0 | 7.0 | | 6.5 | 8.5 | 8.5 | 8.5 | 8.5 | | | | | | 27 |
| 28 | 8.0 | 6.0 | 7.5 | 8.5 | 8.5 | 9.0 | | 9.0 | 8.5 | 10.0 | 10.0 | 10.5 | | | | | | 28 |
| 29 | 10.0 | 8.5 | 10.0 | 11.0 | 9.5 | 10.5 | | 10.5 | 10.5 | 11.0 | 11.5 | 9.5 | | | | | | 29 |
| 30 | 9.8 | 8.5 | 10.0 | 11.5 | 10.0 | 12.0 | | 13.0 | 12.0 | 12.0 | 12.0 | 12.0 | | | | | | 30 |

Lot 1, Effective Resistance

| Sample Number | Initial Frequency (See Note) | After Shock | After Vibration | After Heat Cycling | After Low-Temp. Storage | After Immersion | After Salt Spray | After Moisture Resistance | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Sample Number |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------------|--------------------|-------------------------|-----------------|------------------|----------------------------------------------------------------------------------------------|-------------|------------------|-------------------|-------------------|-------------------|---------------|
| 31 | 90789 | 90798 | 90777 | 90786 | 90789 | 90774 | 90747 | This lot of samples was subjected to the Aging Test and not to the Moisture Resistance test. | 90741 | 90741 | 90741 | 90741 | 90741 | 31 |
| 32 | 90040 | 90040 | 90060 | 90093 | 90081 | 90084 | 90084 | | 90039 | 90030 | 90034 | 90038 | 90043 | 32 |
| 33 | 91419 | 91475 | 91452 | 91384 | 91415 | 91472 | 91478 | | 91460 | 91460 | 91485 | 91483 | 91485 | 33 |
| 34 | 91539 | 91527 | 91543 | 91471 | 91533 | 91535 | 91552 | | 91518 | 91510 | 91503 | 91500 | 91502 | 34 |
| 35 | 91169 | 91154 | 91116 | 91138 | 91133 | 91165 | 91100 | | 91046 | 91040 | 91030 | 91008 | 91000 | 35 |
| 36 | 90543 | 91115 | 91142 | 91052 | 91113 | 91163 | 91133 | | 91118 | 91104 | 91124 | 91104 | 91104 | 36 |
| 37 | 90796 | 90723 | 90731 | 90726 | 90754 | 90791 | 90792 | 90730 | 90730 | 90732 | 90732 | 90736 | 37 | |
| 38 | 91439 | 91456 | 91496 | 91486 | 91585 | 91611 | 91682 | 91631 | 90634 | 90630 | 90630 | 90636 | 38 | |
| 39 | 91734 | 91769 | 91774 | 91782 | 91853 | 91695 | 91680 | 91650 | 91659 | 91656 | 91656 | 91658 | 39 | |
| 40 | 91393 | 91385 | 91390 | 91387 | 91380 | 91389 | 91325 | 91321 | 91314 | 91325 | 91325 | 91320 | 40 | |
| 41 | 91190 | 91142 | 91176 | 91084 | 91137 | 91191 | 91240 | 91238 | 91236 | 91234 | 91234 | 91230 | 41 | |
| 42 | 90970 | 90937 | 90982 | 90854 | 90855 | 90870 | 90934 | 90912 | 90919 | 90920 | 90920 | 90920 | 42 | |
| 43 | 91048 | 91097 | 91123 | 91107 | 91113 | 91131 | 91163 | 91200 | 91215 | 91220 | 91220 | 91220 | 43 | |
| 44 | 90892 | 90803 | 90839 | 90748 | 90801 | 90850 | 90899 | 90825 | 90828 | 90830 | 90830 | 90830 | 44 | |
| 45 | 91265 | 91217 | 91276 | 91157 | 91130 | 91135 | 91107 | 91046 | 91046 | 91037 | 91037 | 91037 | 45 | |
| 46 | 90985 | 90927 | 90910 | 90902 | 90994 | 90942 | 90913 | 90854 | 90853 | 90850 | 90850 | 90838 | 46 | |
| 47 | 91498 | 91451 | 91468 | 91384 | 91345 | 91358 | 91336 | 91304 | 91304 | 91290 | 91284 | 91284 | 47 | |
| 48 | 91396 | 91389 | 91401 | 91392 | 91388 | 91525 | 91508 | 91504 | 91507 | 91497 | 91497 | 91497 | 48 | |
| 49 | 91379 | 91288 | 91252 | 91159 | 91244 | 91280 | 91288 | 91233 | 91242 | 91256 | 91256 | 91259 | 49 | |
| 50 | 90874 | 90894 | 90870 | 90879 | 91006 | 90989 | 91117 | 91107 | 91107 | 91107 | 91107 | 91107 | 50 | |
| 51 | 90896 | 90815 | 90789 | 90862 | 90844 | 90809 | 90795 | 90763 | 90745 | 90748 | 90758 | 90758 | 51 | |
| 52 | 90832 | 90896 | 90915 | 90798 | 90862 | 90944 | 91090 | 91105 | 91115 | 91129 | 91132 | 91132 | 52 | |
| 53 | 90990 | 91065 | 91090 | 91073 | 91073 | 91135 | 91104 | 91065 | 91077 | 91074 | 91078 | 91078 | 53 | |
| 54 | 90714 | 90709 | 90723 | 90628 | 90700 | 90734 | 90782 | 90820 | 90811 | 90800 | 90815 | 90815 | 54 | |
| 55 | 91305 | 91282 | 91302 | 91275 | 91271 | 91290 | 91305 | 91300 | 91299 | 91298 | 91298 | 91280 | 55 | |
| 56 | 90598 | 90558 | 90580 | 90462 | 90562 | 90507 | 90594 | 90575 | 90565 | 90563 | 90563 | 90595 | 56 | |
| 57 | 91339 | 91339 | 91348 | 91348 | 91334 | 91376 | 91354 | 91348 | 91258 | 91329 | 91320 | 91320 | 57 | |
| 58 | 91564 | 91511 | 91514 | 91490 | 91515 | 91547 | 91543 | 91544 | 91521 | 91516 | 91516 | 91500 | 58 | |
| 59 | 91397 | 91328 | 91320 | 91309 | 91300 | 91283 | 91271 | 91256 | 91241 | 91221 | 91221 | 91201 | 59 | |
| 60 | 90886 | 90858 | 90844 | 90803 | 90796 | 90731 | 90724 | 90713 | 90700 | 90688 | 90688 | 90663 | 60 | |
| Notes | The nominal frequency of these crystal units is 19,940.700 cps. The first three digits were dropped from the frequency measurements recorded above. | | | | | | | | | | | | | |

Lot 2, Series Resonant Frequency

| Sample Number | Initial Resistance | After Shock | Vibration After | After Low-Temp. | After Immersion | After Salt Spray | After Mols. Res. | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Storage 2000 hours | Storage 3000 hours | Storage 4000 hours | Storage 5000 hours | Sample Number |
|---------------|--------------------|-------------|-----------------|-----------------|-----------------|------------------|------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------|
| 31 | 8.0 | 6.5 | 6.0 | 6.5 | 5.5 | 6.0 | | 6.5 | 7.0 | 7.0 | 6.0 | 6.0 | | | | | | 31 |
| 32 | 19.5 | 15.0 | 15.0 | 13.5 | 12.0 | 14.5 | | 16.0 | 14.0 | 11.0 | 13.0 | 14.5 | | | | | | 32 |
| 33 | 16.0 | 11.0 | 20.0 | 19.0 | 19.0 | 18.5 | | 16.5 | 13.5 | 10.0 | 11.0 | 12.0 | | | | | | 33 |
| 34 | 9.5 | 6.5 | 8.0 | 10.0 | 10.0 | 14.5 | | 12.0 | 14.0 | 10.5 | 13.0 | 13.0 | | | | | | 34 |
| 35 | 7.0 | 4.5 | 6.0 | 6.8 | 7.0 | 8.5 | | 8.0 | 10.0 | 8.0 | 8.0 | 9.5 | | | | | | 35 |
| 36 | 16.0 | 15.0 | 16.0 | 16.5 | 14.0 | 16.0 | | 16.0 | 14.0 | 11.0 | 12.5 | 14.0 | | | | | | 36 |
| 37 | 10.0 | 8.5 | 7.0 | 6.5 | 5.0 | 10.0 | | 11.5 | 13.0 | 13.0 | 13.0 | 13.0 | | | | | | 37 |
| 38 | 9.8 | 7.0 | 9.0 | 8.5 | 6.5 | 7.5 | | 8.0 | 10.5 | 9.5 | 10.0 | 11.0 | | | | | | 38 |
| 39 | 18.5 | 15.0 | 16.0 | 15.0 | 11.5 | 10.5 | | 10.0 | 12.0 | 14.0 | 14.0 | 13.5 | | | | | | 39 |
| 40 | 7.0 | 5.0 | 6.5 | 5.0 | 4.0 | 6.0 | | 6.5 | 7.0 | 6.0 | 6.5 | 7.0 | | | | | | 40 |
| 41 | 16.0 | 14.0 | 13.5 | 13.0 | 10.0 | 10.0 | | 10.5 | 11.0 | 13.0 | 14.0 | 14.0 | | | | | | 41 |
| 42 | 14.0 | 11.0 | 11.0 | 11.5 | 8.5 | 8.5 | | 8.5 | 9.0 | 10.0 | 13.5 | 13.0 | | | | | | 42 |
| 43 | 7.0 | 5.0 | 5.0 | 5.0 | 3.0 | 5.5 | | 4.5 | 6.5 | 9.0 | 9.0 | 9.5 | | | | | | 43 |
| 44 | 7.0 | 6.5 | 5.5 | 5.0 | 3.0 | 4.5 | | 4.5 | 6.5 | 6.5 | 6.5 | 6.5 | | | | | | 44 |
| 45 | 10.0 | 8.5 | 5.0 | 9.5 | 11.5 | 11.5 | | 13.0 | 13.5 | 14.0 | 16.0 | 17.5 | | | | | | 45 |
| 46 | 9.5 | 5.5 | 10.0 | 6.5 | 5.0 | 5.5 | | 5.0 | 5.5 | 10.0 | 12.5 | 14.0 | | | | | | 46 |
| 47 | 4.0 | 4.5 | 7.8 | 4.5 | 4.5 | 4.5 | | 4.0 | 6.5 | 6.0 | 7.5 | 7.5 | | | | | | 47 |
| 48 | 9.5 | 6.0 | 7.0 | 6.5 | 5.5 | 6.5 | | 7.5 | 8.0 | 10.0 | 12.5 | 12.0 | | | | | | 48 |
| 49 | 4.0 | 4.0 | 4.5 | 4.0 | 4.0 | 4.5 | | 4.5 | 4.5 | 4.5 | 6.0 | 6.5 | | | | | | 49 |
| 50 | 8.0 | 5.5 | 7.5 | 6.5 | 5.0 | 5.0 | | 5.5 | 7.0 | 6.5 | 6.5 | 6.5 | | | | | | 50 |
| 51 | 9.8 | 8.5 | 9.0 | 10.0 | 8.0 | 9.0 | | 10.0 | 10.0 | 12.0 | 13.0 | 14.0 | | | | | | 51 |
| 52 | 14.0 | 11.0 | 12.0 | 11.5 | 10.0 | 14.0 | | 14.5 | 13.0 | 10.0 | 14.0 | 13.0 | | | | | | 52 |
| 53 | 19.5 | 18.0 | 16.0 | 18.5 | 15.5 | 19.0 | | 19.0 | 18.0 | 16.5 | 14.0 | 14.0 | | | | | | 53 |
| 54 | 8.0 | 5.5 | 6.0 | 6.5 | 5.5 | 6.0 | | 6.5 | 7.5 | 9.0 | 9.0 | 9.5 | | | | | | 54 |
| 55 | 8.0 | 5.5 | 7.5 | 6.5 | 5.0 | 5.5 | | 5.5 | 5.0 | 5.0 | 5.5 | 5.0 | | | | | | 55 |
| 56 | 9.5 | 6.5 | 7.0 | 6.5 | 5.5 | 6.5 | | 5.0 | 6.0 | 9.0 | 7.5 | 7.5 | | | | | | 56 |
| 57 | 3.9 | 5.0 | 6.5 | 5.5 | 5.5 | 5.5 | | 5.0 | 5.0 | 4.5 | 5.5 | 5.5 | | | | | | 57 |
| 58 | 3.9 | 5.0 | 5.0 | 5.0 | 4.5 | 6.0 | | 5.0 | 7.5 | 7.5 | 7.5 | 8.0 | | | | | | 58 |
| 59 | 4.3 | 5.5 | 8.5 | 10.5 | 8.5 | 10.0 | | 8.5 | 9.0 | 9.0 | 10.5 | 10.0 | | | | | | 59 |
| 60 | 4.3 | 5.0 | 6.0 | 5.5 | 5.0 | 10.5 | | 10.0 | 12.0 | 11.0 | 10.5 | 10.5 | | | | | | 60 |

| Sample Number | Initial Frequency (See Note) | After Shock | After Vibration | After Low-Temp. Storage | After Immersion | After Salt Spray | After Moisture Resistance | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Sample Number |
|------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-------------|-----------------|-------------------------|-----------------|------------------|---------------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|---------------|
| 19 | 90788 | 90719 | 90755 | 90753 | 90890 | 90952 | | | | | | | | 19 |
| 20 | 90734 | 90775 | 90736 | 90711 | 90849 | 90846 | | | | | | | | 20 |
| 21 | 91159 | 91152 | 91130 | 91115 | 91270 | 91319 | | | | | | | | 21 |
| 22 | 90946 | 90924 | 90935 | 90907 | 91075 | 91101 | | | | | | | | 22 |
| 23 | 91471 | 91443 | 91472 | 91440 | 91594 | 91255 | | | | | | | | 23 |
| 24 | 91335 | 91305 | 91316 | 91445 | 91450 | 91269 | | | | | | | | 24 |
| 25 | 91618 | 91546 | 91544 | 91332 | 91275 | 91643 | | | | | | | | 25 |
| 26 | 91007 | 90940 | 90984 | 91585 | 91128 | 91171 | | | | | | | | 26 |
| 27 | 90562 | 90528 | 90547 | 90990 | 90676 | 90744 | | | | | | | | 27 |
| 28 | 90482 | 90442 | 90472 | 90558 | 90594 | 90633 | | | | | | | | 28 |
| 29 | 90902 | 90872 | 90878 | 90869 | 91015 | 91064 | | | | | | | | 29 |
| 30 | 90746 | 90715 | 90722 | 90721 | 90864 | 90919 | | | | | | | | 30 |
| 31 | 90804 | 90773 | 90764 | 90790 | 91119 | 91195 | | | | | | | | 31 |
| 32 | 90867 | 90838 | 90849 | 90861 | 90991 | 90972 | | | | | | | | 32 |
| 33 | 91681 | 91627 | 91568 | 91490 | 91179 | 91298 | | | | | | | | 33 |
| 34 | 91161 | 91123 | 91131 | 90861 | 91275 | 91292 | | | | | | | | 34 |
| 35 | 91365 | 91335 | 91336 | 91330 | 91471 | 91494 | | | | | | | | 35 |
| 36 | 91660 | 91634 | 91624 | 91354 | 91374 | 91570 | | | | | | | | 36 |
| 37 | 91607 | 91563 | 91590 | 91620 | 91679 | 91686 | | | | | | | | 37 |
| 38 | 91656 | 91663 | 91620 | 91696 | 91411 | 91418 | | | | | | | | 38 |
| 39 | 91033 | 91006 | 91026 | 91624 | 91345 | 91331 | | | | | | | | 39 |
| 40 | 91226 | 91198 | 91219 | 91624 | 91345 | 91331 | | | | | | | | 40 |
| 41 | 90990 | 90962 | 90993 | 90612 | 91124 | 91151 | | | | | | | | 41 |
| 42 | 91386 | 91358 | 91353 | 91378 | 91492 | 91520 | | | | | | | | 42 |
| 43 | 91557 | 91537 | 91553 | 91562 | 91691 | 91506 | | | | | | | | 43 |
| 44 | 91151 | 91130 | 91039 | 91094 | 91261 | 91292 | | | | | | | | 44 |
| 45 | 91033 | 91007 | 91007 | 91016 | 91155 | 91180 | | | | | | | | 45 |
| 46 | 91582 | 91625 | 91601 | 91315 | 90779 | 90807 | | | | | | | | 46 |
| 47 | 91643 | 91560 | 91554 | 91576 | 91570 | 91376 | | | | | | | | 47 |
| 48 | 90802 | 90757 | 90782 | 90771 | 90905 | 90947 | | | | | | | | 48 |
| Note: The nominal frequency of these crystal units is 19,900,700 cps. The first three digits were dropped from the frequencies recorded above. | | | | | | | | | | | | | | 49 |

Lot 3, Series Resonant Frequency

| Sample Number | Initial Resistance | After Shock | After Vibration | After Low-Temp. | After Immersion | After Salt Spray | After Mois. Res. | Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Storage 2000 hours | Storage 3000 hours | Storage 4000 hours | Storage 5000 hours | Sample Number |
|---------------|--------------------|-------------|-----------------|-----------------|-----------------|------------------|------------------|-------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------|
| 60 | 4.0 | 8.5 | 11.0 | 11.0 | 13.0 | 13.5 | 14.0 | | | | | | | | | | | 61 |
| 62 | 5.8 | 5.0 | 10.0 | 8.5 | 9.5 | 9.0 | 9.0 | | | | | | | | | | | 62 |
| 63 | 5.1 | 8.5 | 5.0 | 5.0 | 5.0 | 13.0 | 8.5 | | | | | | | | | | | 63 |
| 64 | 4.0 | 8.5 | 6.5 | 6.0 | 6.0 | 9.5 | 9.0 | | | | | | | | | | | 64 |
| 65 | 4.0 | 5.5 | 7.0 | 7.0 | 6.5 | 5.0 | 9.0 | | | | | | | | | | | 65 |
| 66 | 4.0 | 5.0 | 4.5 | 8.0 | 5.0 | 5.0 | 6.0 | | | | | | | | | | | 66 |
| 67 | 2.7 | 5.8 | 9.0 | 5.0 | 8.0 | 6.0 | 6.0 | | | | | | | | | | | 67 |
| 68 | 5.2 | 6.5 | 10.0 | 7.0 | 12.0 | 7.0 | 9.0 | | | | | | | | | | | 68 |
| 69 | 4.5 | 7.0 | 7.0 | 10.0 | 7.0 | 6.5 | 6.0 | | | | | | | | | | | 69 |
| 70 | 3.4 | 5.5 | 6.0 | 7.0 | 6.5 | 6.5 | 8.0 | | | | | | | | | | | 70 |
| 71 | 3.4 | 5.0 | 4.5 | 5.0 | 5.5 | 5.0 | 5.5 | | | | | | | | | | | 71 |
| 72 | 3.5 | 6.5 | 9.0 | 10.0 | 10.0 | 9.0 | 10.0 | | | | | | | | | | | 72 |
| 73 | 4.5 | 6.5 | 7.0 | 10.0 | 9.0 | 9.5 | 10.0 | | | | | | | | | | | 73 |
| 74 | 4.0 | 4.5 | 4.0 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | 74 |
| 75 | 4.0 | 5.0 | 5.0 | 5.5 | 5.5 | 5.0 | 6.5 | | | | | | | | | | | 75 |
| 76 | 3.5 | 6.5 | 7.5 | 6.5 | 8.0 | 6.5 | 6.5 | | | | | | | | | | | 76 |
| 77 | 6.0 | 7.0 | 8.0 | 8.0 | 6.0 | 6.5 | 7.0 | | | | | | | | | | | 77 |
| 78 | 5.5 | 6.0 | 6.5 | 6.5 | 6.5 | 6.5 | 9.0 | | | | | | | | | | | 78 |
| 79 | 5.5 | 10.0 | 7.0 | 7.0 | 8.0 | 7.0 | 9.0 | | | | | | | | | | | 79 |
| 80 | 5.5 | 5.5 | 10.5 | 8.5 | 11.0 | 12.0 | 12.5 | | | | | | | | | | | 80 |
| 81 | 3.5 | 5.5 | 6.5 | 7.5 | 12.5 | 8.5 | 8.5 | | | | | | | | | | | 81 |
| 82 | 5.0 | 5.5 | 6.0 | 6.0 | 6.5 | 8.5 | 9.0 | | | | | | | | | | | 82 |
| 83 | 4.0 | 5.5 | 6.0 | 5.5 | 6.5 | 8.5 | 9.5 | | | | | | | | | | | 83 |
| 84 | 4.0 | 5.0 | 6.0 | 5.5 | 6.5 | 6.0 | 10.0 | | | | | | | | | | | 84 |
| 85 | 4.0 | 6.0 | 6.5 | 6.5 | 7.0 | 14.0 | 14.5 | | | | | | | | | | | 85 |
| 86 | 5.5 | 6.5 | 16.5 | 16.0 | 12.5 | 10.5 | 10.5 | | | | | | | | | | | 86 |
| 87 | 3.8 | 7.0 | 9.0 | 8.5 | 9.0 | 10.0 | 10.0 | | | | | | | | | | | 87 |
| 88 | 14.0 | 14.5 | 16.5 | 18.5 | 19.0 | 17.0 | 15.5 | | | | | | | | | | | 88 |
| 89 | 6.0 | 8.5 | 9.0 | 8.0 | 9.5 | 12.0 | 10.5 | | | | | | | | | | | 89 |
| 90 | 6.0 | 5.0 | 6.0 | 5.5 | 6.5 | 12.0 | 12.0 | | | | | | | | | | | 90 |

| Sample Number | Initial Frequency (See Note) | After Shock | After Vibration | After Low Temp. Storage | After Immersion | After Salt Spray | After Moisture Resistance | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Sample Number |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------------|-------------------------|-----------------|------------------|---------------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|---------------|
| 91 | 91231 | 91234 | 91270 | 91256 | 90999 | 90999 | | | | | | | | 91 |
| 92 | 91259 | 91238 | 91260 | 91360 | 91090 | 91126 | | | | | | | | 92 |
| 93 | 90490 | 90464 | 90600 | 90500 | 90310 | 90130 | | | | | | | | 93 |
| 94 | 91042 | 91010 | 91144 | 91058 | 90840 | 90870 | | | | | | | | 94 |
| 95 | 91222 | 91135 | 91114 | 91260 | 90999 | 91072 | | | | | | | | 95 |
| 96 | 91544 | 91529 | 91560 | 91632 | 91632 | 91300 | | | | | | | | 96 |
| 97 | 91565 | 91550 | 91630 | 91650 | 91366 | 91438 | | | | | | | | 97 |
| 98 | 90959 | 90931 | 91004 | 91060 | 90958 | 90800 | | | | | | | | 98 |
| 99 | 91286 | 91245 | 91310 | 91300 | 91288 | 90900 | | | | | | | | 99 |
| 100 | 90655 | 90613 | 90541 | 90770 | 90740 | 90722 | | | | | | | | 100 |
| 101 | 90730 | 90688 | 90712 | 90830 | 90525 | 90499 | | | | | | | | 101 |
| 102 | 91037 | 91007 | 90996 | 91060 | 90090 | 90060 | | | | | | | | 102 |
| 103 | 91200 | 91267 | 91214 | 91233 | 91250 | 91297 | | | | | | | | 103 |
| 104 | 90955 | 90912 | 91000 | 91004 | 91000 | 91092 | | | | | | | | 104 |
| 105 | 90925 | 91004 | 91025 | 91000 | 90978 | 90723 | | | | | | | | 105 |
| 106 | 90818 | 90842 | 90905 | 90860 | 90850 | 90755 | | | | | | | | 106 |
| 107 | 90628 | 90700 | 90731 | 90675 | 90652 | 90428 | | | | | | | | 107 |
| 108 | 91300 | 91272 | 90192 | 90300 | 90362 | 90241 | | | | | | | | 108 |
| 109 | 90944 | 90935 | 90950 | 91020 | 91002 | 90977 | | | | | | | | 109 |
| 110 | 91044 | 91055 | 91150 | 91100 | 91090 | 90850 | | | | | | | | 110 |
| 111 | 90700 | 90612 | 90700 | 90765 | 90771 | 91200 | | | | | | | | 111 |
| 112 | 90400 | 90363 | 90358 | 90480 | 90469 | 90421 | | | | | | | | 112 |
| 113 | 90645 | 90620 | 90604 | 90700 | 90695 | 90643 | | | | | | | | 113 |
| 114 | 90976 | 90935 | 90957 | 91000 | 90991 | 90845 | | | | | | | | 114 |
| 115 | 90487 | 90400 | 90367 | 90500 | 90500 | 90566 | | | | | | | | 115 |
| 116 | 90759 | 90780 | 90850 | 90800 | 90803 | 90835 | | | | | | | | 116 |
| 117 | 90694 | 90712 | 90750 | 90750 | 90700 | 90419 | | | | | | | | 117 |
| 118 | 90815 | 90822 | 90920 | 90851 | 90850 | 90836 | | | | | | | | 118 |
| 119 | 90312 | 90270 | 90333 | 90403 | 90370 | 90201 | | | | | | | | 119 |
| 120 | 90354 | 90285 | * | | | | | | | | | | | 120 |
| Note: | The nominal frequency of these crystal units is 19,990,700 cps. The first three digits were dropped from the frequencies recorded above. | | | | | | | | | | | | | |

Lot 4, Series Resonant Frequency

| Sample Number | Initial Resistance | After Shock | After Vibration | After Low-Temp. | After Immersion | After Salt Spray | After Moils. Res. | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Storage 2000 hours | Storage 3000 hours | Storage 4000 hours | Storage 5000 hours | Sample Number |
|---------------|--------------------|-------------|-----------------|-----------------|-----------------|------------------|-------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------|
| 91 | 6.5 | 8.5 | 8.5 | 10.5 | 12.0 | 14.0 | | 17.5 | 19.0 | | | | | | | | | 92 |
| 92 | 6.0 | 5.5 | 4.8 | 6.0 | 6.5 | 5.5 | | 5.0 | 4.5 | | | | | | | | | 93 |
| 93 | 6.2 | 5.0 | 5.5 | 10.0 | 3.9 | 7.1 | | 5.5 | 5.5 | | | | | | | | | 94 |
| 94 | 9.1 | 11.0 | 10.0 | 10.0 | 12.0 | 10.0 | | 10.0 | 10.0 | | | | | | | | | 95 |
| 95 | 7.5 | 6.5 | 6.0 | 6.5 | 7.0 | 7.0 | | 9.0 | 10.0 | | | | | | | | | 96 |
| 96 | 6.8 | 7.0 | 6.5 | 7.0 | 7.5 | 9.0 | | 8.0 | 7.5 | | | | | | | | | 97 |
| 97 | 14.5 | 15.0 | 14.0 | 16.0 | 14.0 | 13.5 | | 13.5 | 13.0 | | | | | | | | | 98 |
| 98 | 4.0 | 5.5 | 5.0 | 7.5 | 5.5 | 9.0 | | 9.0 | 8.5 | | | | | | | | | 99 |
| 99 | 8.0 | 6.5 | 11.3 | 13.0 | 14.0 | 12.6 | | 14.5 | 16.0 | | | | | | | | | 100 |
| 100 | 6.0 | 6.0 | 4.5 | 4.0 | 8.5 | 7.0 | | 8.5 | 10.0 | | | | | | | | | 101 |
| 101 | 6.0 | 6.0 | 6.5 | 4.0 | 5.0 | 5.0 | | 5.0 | 5.0 | | | | | | | | | 102 |
| 102 | 12.7 | 13.0 | 16.0 | 16.0 | 16.0 | 16.0 | | 15.0 | 15.0 | | | | | | | | | 103 |
| 103 | 9.0 | 10.4 | 11.0 | 10.0 | 12.0 | 14.5 | | 14.0 | 14.0 | | | | | | | | | 104 |
| 104 | 12.3 | 12.3 | 12.8 | 10.8 | 12.0 | 20.0 | | 19.0 | 18.5 | | | | | | | | | 105 |
| 105 | 14.0 | 17.0 | 19.0 | 17.5 | 18.0 | 17.0 | | 17.0 | 17.5 | | | | | | | | | 106 |
| 106 | 6.0 | 6.5 | 6.0 | 9.0 | 6.8 | 7.0 | | 7.5 | 8.0 | | | | | | | | | 107 |
| 107 | 7.0 | 7.0 | 6.0 | 6.0 | 8.0 | 11.0 | | 9.0 | 6.5 | | | | | | | | | 108 |
| 108 | 5.0 | 7.0 | 7.0 | 6.6 | 12.0 | 12.0 | | 10.5 | 10.0 | | | | | | | | | 109 |
| 109 | 7.5 | 6.5 | 6.0 | 6.0 | 7.0 | 7.5 | | 7.5 | 7.5 | | | | | | | | | 110 |
| 110 | 13.3 | 18.0 | 14.7 | 14.0 | 11.5 | 15.0 | | 14.0 | 14.0 | | | | | | | | | 111 |
| 111 | 7.5 | 7.0 | 6.5 | 6.5 | 6.0 | 8.5 | | 8.0 | 7.0 | | | | | | | | | 112 |
| 112 | 5.0 | 5.0 | 5.5 | 4.8 | 6.5 | 6.7 | | 6.5 | 6.5 | | | | | | | | | 113 |
| 113 | 8.0 | 8.0 | 9.0 | 8.5 | 9.0 | 12.0 | | 11.0 | 11.0 | | | | | | | | | 114 |
| 114 | 6.4 | 6.0 | 6.0 | 7.0 | 6.0 | 9.0 | | 12.5 | 15.0 | | | | | | | | | 115 |
| 115 | 10.0 | 10.0 | 10.5 | 14.0 | 11.0 | 12.0 | | 12.0 | 10.0 | | | | | | | | | 116 |
| 116 | 4.0 | 4.0 | 5.0 | 7.0 | 5.5 | 6.0 | | 6.0 | 6.0 | | | | | | | | | 117 |
| 117 | 9.0 | 10.0 | 10.0 | 11.5 | 13.0 | 15.0 | | 17.0 | 17.0 | | | | | | | | | 118 |
| 118 | 10.0 | 10.5 | 9.0 | 8.0 | 10.7 | 10.7 | | 12.0 | 12.5 | | | | | | | | | 119 |
| 119 | 5.5 | 12.0 | 9.0 | 8.5 | 6.5 | 6.0 | | 9.8 | 10.0 | | | | | | | | | 120 |
| 120 | 11.0 | 11.0 | * | | | | | | | | | | | | | | | |

Lot 4, Effective Resistance

| Sample Number | Initial Frequency | After Shock | After Vibration | After Low-Temp. Storage | After Immersion | After Salt Spray | After Moisture Resistance | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Sample Number |
|---------------|-------------------|-------------|-----------------|-------------------------|-----------------|------------------|---------------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|---------------|
| 1 | 97627 | 97533 | 97671 | 97800 | 97639 | 9781 | | | | | | | | 1 |
| 2 | 97503 | 97498 | 97600 | 97700 | 97603 | 97697 | | | | | | | | 2 |
| 3 | 97239 | 97217 | 97345 | 97453 | 97341 | 97300 | | | | | | | | 3 |
| 4 | 97258 | 97207 | 97319 | 97400 | 97328 | 97400 | | | | | | | | 4 |
| 5 | 97430 | 97448 | 97556 | 97688 | 97533 | 97600 | | | | | | | | 5 |
| 6 | 97559 | 97478 | 97489 | 97625 | 97544 | 97620 | | | | | | | | 6 |
| 7 | 97362 | 97230 | 97388 | 97500 | 97388 | 97480 | | | | | | | | 7 |
| 8 | 96748 | 96642 | 96781 | 96850 | 96776 | 96858 | | | | | | | | 8 |
| 9 | 96873 | 96759 | 96900 | 96900 | 96830 | 96786 | | | | | | | | 9 |
| 10 | 97725 | 97645 | 97719 | 97800 | 97714 | 97802 | | | | | | | | 10 |
| 11 | 97600 | 97586 | 97733 | 97850 | 97815 | 97888 | | | | | | | | 11 |
| 12 | 97439 | 97393 | 97462 | 97555 | 97534 | 97576 | | | | | | | | 12 |
| 13 | 97015 | 96990 | 97083 | 97015 | 97000 | 97030 | | | | | | | | 13 |
| 14 | 97392 | 97388 | 97464 | 97566 | 97500 | 97563 | | | | | | | | 14 |
| 15 | 97532 | 97460 | 97600 | 97778 | 97676 | 97777 | | | | | | | | 15 |
| 16 | 97388 | 97418 | 97500 | 97573 | 97530 | 97590 | | | | | | | | 16 |
| 17 | 97395 | 97389 | 97550 | 97669 | 97625 | 97676 | | | | | | | | 17 |
| 18 | 97326 | 97238 | 97300 | 97384 | 97327 | 97385 | | | | | | | | 18 |
| 19 | 97263 | 97200 | 97300 | 97200 | 97134 | 97212 | | | | | | | | 19 |
| 20 | 96869 | 96750 | 96800 | 96800 | * | | | | | | | | | 20 |
| 21 | 98121 | 98040 | 98075 | 98000 | 97910 | 97880 | | | | | | | | 21 |
| 22 | 97365 | 97250 | 97300 | 97200 | 97132 | 97199 | | | | | | | | 22 |
| 23 | 98208 | 98150 | 98050 | 98059 | 98036 | 98005 | | | | | | | | 23 |
| 24 | 97600 | 97500 | 97380 | 97515 | 97437 | 97492 | | | | | | | | 24 |
| 25 | 97478 | 97400 | 97425 | 97400 | 97300 | 97300 | | | | | | | | 25 |
| 26 | 97555 | 97475 | 97450 | 97440 | 97334 | 97430 | | | | | | | | 26 |
| 27 | 97514 | 97400 | 97300 | 97450 | 97365 | 97450 | | | | | | | | 27 |
| 28 | 96892 | 97007 | 96905 | 96666 | 96640 | 96701 | | | | | | | | 28 |
| 29 | 97382 | 97280 | 97300 | 97100 | 97050 | 96900 | | | | | | | | 29 |
| 30 | 97165 | 97000 | 97070 | 97100 | 97005 | 97005 | | | | | | | | 30 |

| Sample Number | Initial Resistance | After Shock | After Vibration | After Low-Temp. | After Immersion | After Salt Spray | After Mois. Res. | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Storage 2000 hours | Storage 3000 hours | Storage 4000 hours | Storage 5000 hours | Sample Number |
|---------------|--------------------|-------------|-----------------|-----------------|-----------------|------------------|------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------|
| 1 | 18.2 | 17.5 | 18.0 | 20.0 | 18.0 | 18.0 | 18.0 | | | | | | | | | | | 1 |
| 2 | 18.7 | 18.5 | 19.6 | 21.2 | 19.6 | 19.6 | 19.6 | | | | | | | | | | | 2 |
| 3 | 22.0 | 20.5 | 22.0 | 24.5 | 22.0 | 22.0 | 22.0 | | | | | | | | | | | 3 |
| 4 | 22.0 | 20.0 | 21.3 | 25.0 | 21.3 | 21.3 | 21.3 | | | | | | | | | | | 4 |
| 5 | 34.0 | 32.5 | 34.0 | 34.0 | 33.0 | 33.0 | 33.0 | | | | | | | | | | | 5 |
| 6 | 23.0 | 23.0 | 24.5 | 26.7 | 24.5 | 24.5 | 24.0 | | | | | | | | | | | 6 |
| 7 | 18.7 | 18.0 | 18.0 | 21.0 | 18.0 | 18.0 | 24.0 | | | | | | | | | | | 7 |
| 8 | 22.0 | 22.0 | 22.0 | 25.0 | 22.0 | 22.0 | 19.5 | | | | | | | | | | | 8 |
| 9 | 27.7 | 25.0 | 27.0 | 29.7 | 26.4 | 23.3 | 23.3 | | | | | | | | | | | 9 |
| 10 | 22.0 | 21.5 | 22.0 | 29.0 | 25.0 | 28.0 | 28.0 | | | | | | | | | | | 10 |
| 11 | 22.0 | 22.0 | 22.0 | 25.0 | 22.0 | 22.0 | 25.0 | | | | | | | | | | | 11 |
| 12 | 28.7 | 28.0 | 28.0 | 34.0 | 28.0 | 28.7 | 22.6 | | | | | | | | | | | 12 |
| 13 | 33.3 | 31.5 | 31.5 | 36.0 | 28.7 | 28.7 | 28.7 | | | | | | | | | | | 13 |
| 14 | 28.7 | 26.0 | 28.0 | 29.7 | 27.5 | 30.0 | 30.0 | | | | | | | | | | | 14 |
| 15 | 23.3 | 23.0 | 25.5 | 27.0 | 25.5 | 28.0 | 28.0 | | | | | | | | | | | 15 |
| 16 | 28.7 | 27.0 | 28.0 | 33.3 | 28.0 | 25.5 | 25.5 | | | | | | | | | | | 16 |
| 17 | 28.7 | 26.0 | 27.0 | 27.0 | 25.5 | 27.0 | 27.0 | | | | | | | | | | | 17 |
| 18 | 22.0 | 20.5 | 21.0 | 24.4 | 22.0 | 25.0 | 25.0 | | | | | | | | | | | 18 |
| 19 | 23.3 | 25.0 | 24.4 | 27.0 | 24.4 | 24.4 | 24.4 | | | | | | | | | | | 19 |
| 20 | 34.0 | 34.0 | 36.5 | 40.0 | * | 24.4 | 24.4 | | | | | | | | | | | 20 |
| 21 | 34.0 | 33.3 | 33.3 | 37.0 | 34.0 | 34.0 | 34.0 | | | | | | | | | | | 21 |
| 22 | 31.0 | 30.0 | 33.3 | 35.0 | 30.0 | 32.0 | 32.0 | | | | | | | | | | | 22 |
| 23 | 28.7 | 27.0 | 27.5 | 30.5 | 28.7 | 30.5 | 30.5 | | | | | | | | | | | 23 |
| 24 | 28.0 | 27.0 | 28.0 | 31.4 | 28.7 | 28.7 | 28.7 | | | | | | | | | | | 24 |
| 25 | 25.0 | 25.0 | 25.0 | 28.0 | 25.0 | 26.0 | 26.0 | | | | | | | | | | | 25 |
| 26 | 22.0 | 20.0 | 20.0 | 23.4 | 21.0 | 21.0 | 21.0 | | | | | | | | | | | 26 |
| 27 | 28.7 | 29.0 | 30.0 | 33.3 | 28.0 | 29.0 | 29.0 | | | | | | | | | | | 27 |
| 28 | 34.0 | 28.7 | 30.0 | 28.7 | 29.0 | 30.0 | 30.0 | | | | | | | | | | | 28 |
| 29 | 27.7 | 25.0 | 28.0 | 30.0 | 28.0 | 34.0 | 34.0 | | | | | | | | | | | 29 |
| 30 | 34.0 | 34.0 | 31.5 | 34.0 | 35.2 | 35.0 | 35.0 | | | | | | | | | | | 30 |

Lot 5, Effective Resistance

| Sample Number | Initial Frequency (See Note) | After Shock | After Vibration | After Heat Cycling | After Low Temp. Storage | After Immersion | After Salt Spray | After Moisture Resistance | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Sample Number |
|---------------|------------------------------|-------------|-----------------|--------------------|-------------------------|-----------------|------------------|---------------------------|-------------|------------------|-------------------|-------------------|-------------------|---------------|
| A1 | 96960 | 96796 | 96730 | 96746 | 97158 | 97000 | 97046 | | 96832 | 97000 | 96890 | 97064 | 96985 | A1 |
| A2 | 97040 | 96966 | 96835 | 96901 | 97223 | 97255 | 97293 | | 97186 | 97075 | 97091 | 97098 | 96924 | A2 |
| A3 | 97589 | 97581 | 97513 | 97499 | 97890 | 97840 | 97826 | | * | | | | | A3 |
| A4 | 96831 | 96831 | 96698 | 96824 | 97232 | 97180 | 97191 | | 96941 | 96941 | 97045 | 97033 | 97065 | A4 |
| A5 | 97398 | 97339 | 97208 | 97307 | 97208 | 97115 | 97168 | | 97300 | 97400 | 97525 | 97500 | 97500 | A5 |
| A6 | 97042 | 96954 | 96900 | 96950 | 97291 | 97267 | 97302 | | 97231 | 97131 | 97038 | 96993 | 96946 | A6 |
| A7 | 97551 | 97511 | 97464 | 97464 | 97948 | 97796 | 97845 | | 97600 | 97473 | 97575 | 97591 | 97574 | A7 |
| A8 | 97336 | 97293 | 97180 | 97158 | 97580 | 97577 | 97542 | | 97419 | 97397 | 97097 | 97068 | 97019 | A8 |
| A9 | 96204 | 96154 | 96049 | 96040 | 96447 | 96369 | 96181 | | 96169 | 96098 | 96118 | 96169 | 96169 | A9 |
| A10 | 97383 | 97341 | 97168 | 97221 | 97631 | 97629 | 97641 | | 97413 | 97396 | 97542 | 97490 | 97434 | A10 |
| A11 | 97590 | 97554 | 97443 | 97420 | 97775 | 97850 | 97824 | | 97439 | 97371 | 97934 | 97976 | 97937 | A11 |
| A12 | 97151 | 97059 | 96994 | 96965 | 97359 | 97385 | 97343 | | 97517 | 97761 | 97769 | 97758 | 97826 | A12 |
| A13 | 97477 | 97433 | 97371 | 97389 | 97777 | 97720 | 97741 | | ** | | | | | A13 |
| A14 | 97237 | 97213 | 97064 | 97138 | 97534 | 97535 | 97533 | | 97371 | 97348 | 97453 | 97519 | 97395 | A14 |
| A15 | 97442 | 97393 | 97270 | 97308 | 97733 | 97722 | 97710 | | 97500 | 97436 | 97322 | 97329 | 97366 | A15 |
| A16 | 97170 | 97117 | 97012 | 97032 | 97403 | 97400 | 97466 | | 97262 | 97265 | 97300 | 97347 | 97110 | A16 |
| A17 | 97563 | 97566 | 97463 | 97459 | 97843 | 97810 | 97940 | | 97851 | 97657 | 97637 | 97642 | 97442 | A17 |
| A18 | 97314 | 97352 | 97156 | 97129 | 97559 | 97600 | 97620 | | 97394 | 97332 | 97412 | 97416 | 97315 | A18 |
| A19 | 97264 | 97212 | 97116 | 97134 | 97526 | 97530 | 97523 | | 97300 | 97290 | 97377 | 97308 | 97260 | A19 |
| A20 | 97029 | 96945 | 96833 | 96830 | 97249 | 97235 | 97215 | | 96997 | 96990 | 97160 | 97116 | 96893 | A20 |
| A21 | 96797 | 96744 | 96638 | 96636 | 96710 | 97040 | 97054 | | 96985 | 96922 | 96968 | 96703 | 96685 | A21 |
| A22 | 96599 | 96519 | 96425 | 96438 | 96806 | 96791 | 96810 | | 96632 | 96604 | 96585 | 96590 | 96598 | A22 |
| A23 | 97288 | 97265 | 97151 | 97162 | 97375 | 97577 | 97572 | | 97455 | 97300 | 97464 | 97423 | 97405 | A23 |
| A24 | 97564 | 97543 | 97435 | 97450 | 97483 | 97621 | 97876 | | 97636 | 97649 | 97670 | 97556 | 97520 | A24 |
| A25 | 97381 | 97542 | 97240 | 97102 | 97104 | 97214 | 97508 | | 97345 | 97245 | 97167 | 97272 | 97163 | A25 |
| A26 | 97626 | 97612 | 97518 | 97514 | 97587 | 97670 | 97642 | | 97624 | 97644 | 97693 | 97656 | 97568 | A26 |
| A27 | 97026 | 97091 | 96944 | 97012 | 97157 | 97356 | 97428 | | 97243 | 97214 | 97311 | ** | | A27 |
| A28 | 97668 | 97685 | 97592 | 97637 | 97801 | 97979 | 98065 | | 98086 | 97936 | 97837 | 97773 | 97141 | A28 |
| A29 | 97145 | 97113 | 96960 | 97019 | 97072 | 97209 | 97297 | | 97400 | 97373 | 97380 | 97421 | 97500 | A29 |
| A30 | 97559 | 97337 | 97456 | 97461 | 97590 | 97587 | 97658 | | 97578 | 97550 | 97628 | 97658 | 97640 | A30 |

Note: The nominal frequency of these crystal units is 19,997,000 cps. The first three digits were dropped from the frequency measurements recorded above.

Lot 6, Series Resonant Frequency

| Sample Number | Initial Resistance | After Shock | After Vibration | After Low-Temp. | After Immersion | After Salt Spray | After Mois. Res. | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Storage 2000 hours | Storage 3000 hours | Storage 4000 hours | Storage 5000 hours | Sample Number |
|---------------|--------------------|-------------|-----------------|-----------------|-----------------|------------------|------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------|
| A1 | 24.7 | 20.5 | 20.0 | 20.0 | 20.5 | 21.0 | | 22.0 | 22.0 | 22.0 | 21.3 | 22.4 | | | | | | A1 |
| A2 | 24.7 | 25.0 | 21.4 | 20.4 | 22.0 | 21.0 | | 24.0 | 22.0 | 21.4 | 22.0 | 22.0 | | | | | | A2 |
| A3 | 23.2 | 23.2 | 21.0 | 22.0 | 27.6 | 22.0 | | * | | | | | | | | | | A3 |
| A4 | 26.0 | 25.0 | 25.0 | 24.5 | 25.0 | 26.7 | | 28.3 | 27.0 | 26.0 | 28.3 | 28.3 | | | | | | A4 |
| A5 | 23.8 | 20.0 | 24.5 | 24.5 | 25.0 | 24.5 | | 26.0 | 26.0 | 25.0 | 27.0 | 27.6 | | | | | | A5 |
| A6 | 26.0 | 19.5 | 25.0 | 25.2 | 27.0 | 25.3 | | 28.0 | 26.3 | 26.0 | 27.4 | 27.4 | | | | | | A6 |
| A7 | 20.9 | 31.5 | 21.0 | 21.5 | 22.6 | 21.5 | | 23.4 | 22.8 | 20.0 | 24.0 | 22.7 | | | | | | A7 |
| A8 | 20.9 | 23.5 | 19.5 | 21.0 | 21.0 | 21.0 | | 24.6 | 24.6 | 22.9 | 24.0 | 24.0 | | | | | | A8 |
| A9 | 31.9 | 30.0 | 30.7 | 32.0 | 34.3 | 36.3 | | 38.0 | 38.2 | 39.0 | 40.0 | 40.0 | | | | | | A9 |
| A10 | 24.7 | 18.5 | 24.5 | 24.6 | 24.5 | 24.5 | | 27.0 | 25.3 | 24.6 | 25.0 | 25.0 | | | | | | A10 |
| A11 | 31.1 | 27.0 | 30.0 | 30.0 | 32.0 | 32.2 | | 25.6 | 25.0 | 25.0 | 27.0 | 27.0 | | | | | | A11 |
| A12 | 20.1 | 18.0 | 26.0 | 19.5 | 21.5 | 21.0 | | 24.0 | 23.0 | 22.0 | 24.1 | 25.3 | | | | | | A12 |
| A13 | 18.2 | 20.0 | 17.8 | 18.2 | 24.5 | 18.0 | | ** | | | | | | | | | | A13 |
| A14 | 21.5 | 22.0 | 25.3 | 19.0 | 19.5 | 19.5 | | 25.7 | 20.0 | 19.6 | 21.3 | 20.0 | | | | | | A14 |
| A15 | 22.0 | 20.5 | 21.5 | 22.7 | 23.0 | 24.0 | | 24.8 | 24.6 | 23.0 | 25.0 | 25.3 | | | | | | A15 |
| A16 | 24.4 | 17.5 | 22.6 | 22.6 | 24.5 | 24.5 | | 25.0 | 24.8 | 24.0 | 25.0 | 25.0 | | | | | | A16 |
| A17 | 24.4 | 31.5 | 21.0 | 22.0 | 27.6 | 24.0 | | 22.8 | 30.0 | 30.1 | 31.0 | 31.0 | | | | | | A17 |
| A18 | 26.4 | 23.6 | 18.0 | 18.5 | 20.2 | 18.0 | | 18.0 | 18.0 | 17.0 | 18.0 | 18.0 | | | | | | A18 |
| A19 | 32.7 | 20.6 | 30.0 | 32.7 | 32.0 | 32.7 | | 34.3 | 33.0 | 30.6 | 33.3 | 33.3 | | | | | | A19 |
| A20 | 26.0 | 29.5 | 23.5 | 24.5 | 25.0 | 26.0 | | 26.5 | 27.4 | 24.4 | 27.0 | 26.3 | | | | | | A20 |
| A21 | 22.8 | 30.0 | 22.0 | 23.0 | 24.0 | 24.0 | | 28.3 | 27.5 | 25.8 | 29.7 | 27.0 | | | | | | A21 |
| A22 | 32.0 | 19.4 | 30.0 | 30.0 | 31.1 | 31.0 | | 38.0 | 38.0 | 35.0 | 34.5 | 37.0 | | | | | | A22 |
| A23 | 31.5 | 29.5 | 30.0 | 30.0 | 31.5 | 30.0 | | 32.2 | 30.2 | 30.6 | 32.1 | 36.4 | | | | | | A23 |
| A24 | 21.0 | 20.5 | 19.5 | 21.0 | 22.0 | 20.0 | | 25.0 | 23.6 | 21.3 | 23.3 | 24.0 | | | | | | A24 |
| A25 | 31.0 | 24.5 | 33.6 | 32.8 | 32.0 | 32.5 | | 33.1 | 33.1 | 33.1 | 33.1 | 33.1 | | | | | | A25 |
| A26 | 21.4 | 24.5 | 21.5 | 21.5 | 23.5 | 23.6 | | 24.2 | 24.0 | 21.0 | 21.7 | 24.2 | | | | | | A26 |
| A27 | 21.4 | 24.5 | 24.5 | 25.3 | 28.6 | 25.0 | | 27.0 | 27.0 | 27.6 | *** | | | | | | | A27 |
| A28 | 21.4 | 24.5 | 25.3 | 25.3 | 28.0 | 24.5 | | 23.0 | 22.5 | 20.0 | 20.5 | 22.0 | | | | | | A28 |
| A29 | 19.7 | 19.5 | 20.0 | 20.7 | 21.0 | 21.0 | | 27.5 | 26.8 | 28.0 | 27.6 | 26.6 | | | | | | A29 |
| A30 | 32.8 | 33.4 | 30.1 | 30.0 | 30.5 | 30.0 | | 32.0 | 33.0 | 29.7 | 33.1 | 32.9 | | | | | | A30 |

Lot 6, Effective Resistance

| Sample Number | Initial Frequency (See Note) | After Shock | After Vibration | After Low-Temp. Storage | After Immersion | After Salt Spray | After Moisture Resistance | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Sample Number |
|------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-------------|-----------------|-------------------------|-----------------|------------------|---------------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|---------------|
| 1 | 96681 | 96560 | 96555 | 96833 | 96899 | 97016 | 97022 | | | | | | | 1 |
| 2 | 97086 | 96992 | 96968 | 97210 | 97235 | 97378 | 97388 | | | | | | | 2 |
| 3 | 96426 | 96315 | 96252 | 96507 | 96566 | 96741 | 96825 | | | | | | | 3 |
| 4 | 97234 | 97110 | 97103 | 97406 | 97474 | 97462 | 97450 | | | | | | | 4 |
| 5 | 96883 | 96789 | 96780 | 97043 | 97129 | 97241 | 97258 | | | | | | | 5 |
| 6 | 96105 | 96032 | 96012 | 96171 | 96300 | 96411 | 96414 | | | | | | | 6 |
| 7 | 97764 | 97656 | 97664 | 97057 | 97100 | 97226 | 97229 | | | | | | | 7 |
| 8 | 96886 | 96775 | 96769 | 97020 | 97117 | 97235 | 97264 | | | | | | | 8 |
| 9 | 97156 | 97050 | 97022 | 97287 | 97139 | 97187 | 97185 | | | | | | | 9 |
| 10 | 97262 | 97113 | 97125 | 97434 | 97135 | 97372 | 97377 | | | | | | | 10 |
| 11 | 97371 | 97240 | 97262 | 97523 | 97604 | 97714 | 97717 | | | | | | | 11 |
| 12 | 96803 | 96672 | 96650 | 96925 | 97027 | 96245 | 96240 | | | | | | | 12 |
| 13 | 96867 | 96765 | 96751 | 96924 | 97012 | 96909 | 96914 | | | | | | | 13 |
| 14 | 96762 | 96611 | 96647 | 96944 | 97000 | 96894 | 96885 | | | | | | | 14 |
| 15 | 97310 | 97202 | 97212 | 97284 | 97137 | * | | | | | | | | 15 |
| 16 | 96933 | 96836 | 96819 | 97070 | 97222 | 97325 | | 97322 | | | | | | 16 |
| 17 | 96995 | 96879 | 96833 | 97096 | 96700 | 97327 | | 97328 | | | | | | 17 |
| 18 | 96474 | 96413 | 96352 | 96658 | 96700 | 96855 | | 96843 | | | | | | 18 |
| 19 | 97248 | 97154 | 97133 | 97373 | 97382 | * | | | | | | | | 19 |
| 20 | 97058 | 96972 | 96954 | 97130 | 97333 | 97567 | | | | | | | | 20 |
| 21 | 96563 | 96478 | * | | | | | | | | | | | 21 |
| 22 | 97100 | 97029 | 97007 | 97267 | 97282 | 96953 | | 96350 | | | | | | 22 |
| 23 | 96493 | 96411 | 96396 | 96673 | 96787 | 96564 | | 96544 | | | | | | 23 |
| 24 | 97316 | 97241 | 97290 | 98105 | 97575 | 97567 | | 97570 | | | | | | 24 |
| 25 | 97079 | 97001 | 96997 | 97288 | 97369 | 97453 | | 97462 | | | | | | 25 |
| 26 | 96273 | 96186 | 96185 | 96444 | 96565 | 96667 | | 96685 | | | | | | 26 |
| 27 | 96063 | 96174 | * | | | | | | | | | | | 27 |
| 28 | 96624 | 96535 | 96495 | * | | | | | | | | | | 28 |
| 29 | 96114 | 96054 | 96022 | 96200 | 96403 | 96543 | | 96530 | | | | | | 29 |
| 30 | 97058 | 96947 | 96821 | 96985 | 96840 | 96891 | | 96904 | | | | | | 30 |
| Note: The nominal frequency of these crystal units is 49,997,000 cps. The first three digits were dropped from the frequencies recorded above. | | | | | | | | | | | | | | |

Lot 9, Series Resonant Frequency

| Sample Number | Initial Resistance | After Shock | After Vibration | After Low-Temp. | After Immersion | After Salt Spray | After Mols. Res. | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Storage 2000 hours | Storage 3000 hours | Storage 4000 hours | Storage 5000 hours | Sample Number |
|---------------|--------------------|-------------|-----------------|-----------------|-----------------|------------------|------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------|
| 1 | 25.0 | 26.2 | 24.6 | 25.0 | 24.0 | 26.0 | 24.0 | | | | | | | | | | | 1 |
| 2 | 25.0 | 25.0 | 25.3 | 26.5 | 25.6 | 27.3 | 25.2 | | | | | | | | | | | 2 |
| 3 | 26.5 | 27.0 | 24.0 | 26.5 | 25.0 | 26.0 | 25.0 | | | | | | | | | | | 3 |
| 4 | 32.0 | 29.5 | 30.4 | 31.0 | 31.0 | 30.0 | 34.0 | | | | | | | | | | | 4 |
| 5 | 28.4 | 30.4 | 28.4 | 28.0 | 28.3 | 29.6 | 28.3 | | | | | | | | | | | 5 |
| 6 | 30.0 | 32.0 | 31.0 | 33.3 | 32.0 | 33.1 | 32.6 | | | | | | | | | | | 6 |
| 7 | 29.2 | 29.2 | 31.0 | 31.6 | 31.6 | 32.4 | 31.0 | | | | | | | | | | | 7 |
| 8 | 26.5 | 28.3 | 29.5 | 27.0 | 27.2 | 27.2 | 26.0 | | | | | | | | | | | 8 |
| 9 | 29.0 | 30.0 | 28.6 | 30.0 | 30.0 | 31.6 | 33.0 | | | | | | | | | | | 9 |
| 10 | 32.5 | 33.5 | 29.8 | 32.2 | 31.5 | 30.2 | 30.4 | | | | | | | | | | | 10 |
| 11 | 32.1 | 32.0 | 30.5 | 30.5 | 29.0 | 31.0 | 33.0 | | | | | | | | | | | 11 |
| 12 | 32.1 | 32.1 | 32.0 | 32.0 | 31.1 | 31.9 | 34.6 | | | | | | | | | | | 12 |
| 13 | 27.3 | 30.0 | 32.0 | 28.0 | 29.6 | 31.6 | 32.0 | | | | | | | | | | | 13 |
| 14 | 31.8 | 33.5 | 32.5 | 32.0 | 32.0 | 32.4 | 30.9 | | | | | | | | | | | 14 |
| 15 | 26.4 | 28.0 | 27.0 | 30.0 | 28.6 | * | | | | | | | | | | | | 15 |
| 16 | 24.0 | 23.6 | 26.5 | 27.8 | 27.0 | 28.3 | | 26.0 | | | | | | | | | | 16 |
| 17 | 34.4 | 35.0 | 36.2 | 37.0 | 37.0 | 38.0 | | 37.0 | | | | | | | | | | 17 |
| 18 | 34.4 | 35.6 | 35.6 | 34.4 | 37.0 | 37.4 | | 36.0 | | | | | | | | | | 18 |
| 19 | 27.3 | 24.9 | 28.0 | 28.0 | 30.8 | * | | | | | | | | | | | | 19 |
| 20 | 27.3 | 24.0 | 28.0 | 28.6 | 27.0 | 29.0 | | 28.3 | | | | | | | | | | 20 |
| 21 | 37.1 | 34.3 | * | | | | | | | | | | | | | | | 21 |
| 22 | 31.2 | 31.2 | 35.0 | 36.0 | 32.0 | 35.4 | | 37.2 | | | | | | | | | | 22 |
| 23 | 31.2 | 33.0 | 32.4 | 33.3 | 30.4 | 32.0 | | 33.0 | | | | | | | | | | 23 |
| 24 | 23.0 | 27.0 | 30.5 | 32.3 | 33.0 | 36.3 | | 40.0 | | | | | | | | | | 24 |
| 25 | 35.0 | 35.0 | 34.3 | 34.6 | 34.0 | 38.0 | | 36.2 | | | | | | | | | | 25 |
| 26 | 29.0 | 32.4 | 30.6 | 27.9 | 30.0 | 28.0 | | 30.2 | | | | | | | | | | 26 |
| 27 | 29.5 | 31.3 | * | | | | | | | | | | | | | | | 27 |
| 28 | 37.5 | 35.0 | 36.3 | * | | | | | | | | | | | | | | 28 |
| 29 | 37.5 | 36.5 | 36.0 | 37.0 | 35.5 | 37.0 | | 35.0 | | | | | | | | | | 29 |
| 30 | 30.0 | 30.5 | 30.4 | 30.7 | 31.3 | 34.4 | | 34.3 | | | | | | | | | | 30 |

Lot 9. Effective Resistance

| Sample Number | Initial Frequency (See Note) | After Shock | After Vibration | After Low-Temp. Storage | After Immersion | After Salt Spray | After Moisture Resistance | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Sample Number |
|---------------|------------------------------|-------------|-----------------|-------------------------|-----------------|------------------|---------------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|---------------|
| 1 | 90538 | 90559 | 90530 | 90563 | | | | | | | | | | 1 |
| 2 | 90425 | 90525 | 90431 | 90500 | | | | | | | | | | 2 |
| 3 | 90657 | 90725 | 90722 | 90666 | | | | | | | | | | 3 |
| 4 | 90415 | 90430 | 90435 | 90413 | | | | | | | | | | 4 |
| 5 | 90738 | 90520 | 90545 | 90715 | | | | | | | | | | 5 |
| 6 | 90365 | 90444 | 90463 | 90437 | | | | | | | | | | 6 |
| 7 | 90325 | 90300 | 90245 | 90329 | | | | | | | | | | 7 |
| 8 | 90474 | 90500 | 90422 | 90393 | | | | | | | | | | 8 |
| 9 | 90367 | 90450 | 90379 | 90385 | | | | | | | | | | 9 |
| 10 | 90478 | 90509 | 90488 | 90467 | | | | | | | | | | 10 |
| 11 | 90719 | 90803 | 90710 | 90700 | | | | | | | | | | 11 |
| 12 | 90640 | 90729 | 90668 | 90663 | | | | | | | | | | 12 |
| 13 | 90479 | 90555 | 90551 | 90469 | | | | | | | | | | 13 |
| 14 | 90320 | 90400 | 90315 | 90336 | | | | | | | | | | 14 |
| 15 | 90380 | 90475 | 90395 | 90400 | | | | | | | | | | 15 |
| 16 | 90500 | 90554 | 90505 | 90528 | | | | | | | | | | 16 |
| 17 | 90545 | 90470 | 90372 | 90385 | | | | | | | | | | 17 |
| 18 | 90400 | 90568 | 90507 | 90560 | | | | | | | | | | 18 |
| 19 | 90577 | 90609 | 90553 | 90567 | | | | | | | | | | 19 |
| 20 | 90206 | 90219 | 90129 | 90101 | | | | | | | | | | 20 |
| 21 | 90363 | 90425 | 90363 | 90376 | | | | | | | | | | 21 |
| 22 | 90759 | 90824 | 90763 | 90790 | | | | | | | | | | 22 |
| 23 | 90418 | 90494 | 90398 | 90417 | | | | | | | | | | 23 |
| 24 | 90150 | 90269 | 90198 | 90222 | | | | | | | | | | 24 |
| 25 | 90779 | 90325 | 90781 | 90800 | | | | | | | | | | 25 |
| 26 | 90270 | 90307 | 90323 | 90243 | | | | | | | | | | 26 |
| 27 | 90480 | 90524 | 90429 | 90512 | | | | | | | | | | 27 |
| 28 | 90214 | 90245 | 90202 | 90242 | | | | | | | | | | 28 |
| 29 | 90420 | 90466 | 90409 | 90442 | | | | | | | | | | 29 |
| 30 | 91260 | 91300 | 91253 | 91225 | | | | | | | | | | 30 |

Lot 11, Series Resonant Frequency

| Sample Number | Initial Frequency (See Note) | After Shock | After Vibration | After Low-Temp. Storage | After Immersion | After Salt Spray | After Moisture Resistance | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Sample Number |
|---------------|------------------------------|-------------|-----------------|-------------------------|-----------------|------------------|---------------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|---------------|
| 31 | 90145 | 90212 | 90200 | 90204 | | | | | | | | | | 31 |
| 32 | 90516 | 90600 | 90554 | 90575 | | | | | | | | | | 32 |
| 33 | 90440 | 90524 | 90490 | 90484 | | | | | | | | | | 33 |
| 34 | 90873 | 90970 | 90895 | 90980 | | | | | | | | | | 34 |
| 35 | 90617 | 90705 | 90639 | 90654 | | | | | | | | | | 35 |
| 36 | 90500 | 90568 | 90527 | 90527 | | | | | | | | | | 36 |
| 37 | 90633 | 90717 | 90681 | 90665 | | | | | | | | | | 37 |
| 38 | 90365 | 90457 | 90415 | 90423 | | | | | | | | | | 38 |
| 39 | 90270 | 90355 | 90318 | 90326 | | | | | | | | | | 39 |
| 40 | 90350 | 90411 | 90397 | 90389 | | | | | | | | | | 40 |
| 41 | 90300 | 90303 | 90351 | 90370 | | | | | | | | | | 41 |
| 42 | 90215 | 90315 | 90285 | 90291 | | | | | | | | | | 42 |
| 43 | 90500 | 90600 | 90570 | 90563 | | | | | | | | | | 43 |
| 44 | 90594 | 90571 | 90635 | 90648 | | | | | | | | | | 44 |
| 45 | 90380 | 90450 | 90445 | 90439 | | | | | | | | | | 45 |
| 46 | 90322 | 90400 | 90378 | 90360 | | | | | | | | | | 46 |
| 47 | 90425 | 90499 | 90478 | 90483 | | | | | | | | | | 47 |
| 48 | 90283 | 90350 | 90313 | 90330 | | | | | | | | | | 48 |
| 49 | 90650 | 90730 | 90690 | 90700 | | | | | | | | | | 49 |
| 50 | 90152 | 90250 | 90200 | 90215 | | | | | | | | | | 50 |
| 51 | 90160 | 90237 | 90233 | 90207 | | | | | | | | | | 51 |
| 52 | 90400 | 90454 | 90431 | 90448 | | | | | | | | | | 52 |
| 53 | 90420 | 90500 | 90472 | 90480 | | | | | | | | | | 53 |
| 54 | 90450 | 90511 | 90487 | 90474 | | | | | | | | | | 54 |
| 55 | 90535 | 90601 | 90581 | 90580 | | | | | | | | | | 55 |
| 56 | 90346 | 90413 | 90378 | 90350 | | | | | | | | | | 56 |
| 57 | 90400 | 90470 | 90434 | 90452 | | | | | | | | | | 57 |
| 58 | 90360 | 90402 | 90354 | 90373 | | | | | | | | | | 58 |
| 59 | 89810 | 89904 | 89877 | 89899 | | | | | | | | | | 59 |
| 60 | 90637 | 90680 | 90665 | 90693 | | | | | | | | | | 60 |

Lot 12, Series Resonant Frequency

| Sample Number | Initial Resistance | After Shock | After Vibration | After Low-Temp. | After Immersion | After Salt Spray | After Mols. Res. | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Storage 2000 hours | Storage 3000 hours | Storage 4000 hours | Storage 5000 hours | Sample Number |
|---------------|--------------------|-------------|-----------------|-----------------|-----------------|------------------|------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------|
| 60 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 19 |
| 61 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 20 |
| 62 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 21 |
| 63 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 22 |
| 64 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 23 |
| 65 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 24 |
| 66 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 25 |
| 67 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 26 |
| 68 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 27 |
| 69 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 28 |
| 70 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 29 |
| 71 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 30 |
| 72 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 31 |
| 73 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 32 |
| 74 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 33 |
| 75 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 34 |
| 76 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 35 |
| 77 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 36 |
| 78 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 37 |
| 79 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 38 |
| 80 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 39 |
| 81 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 40 |
| 82 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 41 |
| 83 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 42 |
| 84 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 43 |
| 85 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 44 |
| 86 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 45 |
| 87 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 46 |
| 88 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 47 |
| 89 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 48 |
| 90 | 4.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 49 |

Lot 12, Effective Resistance

Lot 13, Series Resonant Frequency

| Sample Number | Initial Frequency (See Note) | After Shock | After Vibration | After Low-Temp. Storage | After Immersion | After Salt Spray | After Moisture Resistance | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Sample Number |
|---------------|------------------------------|-------------|-----------------|-------------------------|-----------------|------------------|---------------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|---------------|
| 61 | 90245 | 90313 | 90226 | 90330 | | | | | | | | | | 61 |
| 62 | 90255 | 90332 | 90236 | 90329 | | | | | | | | | | 62 |
| 63 | 89775 | 89858 | 89868 | 90822 | | | | | | | | | | 63 |
| 64 | 90680 | 90756 | 90669 | 90748 | | | | | | | | | | 64 |
| 65 | 90345 | 90433 | 90351 | 90348 | | | | | | | | | | 65 |
| 66 | 90522 | 90600 | 90597 | 90600 | | | | | | | | | | 66 |
| 67 | 90300 | 90977 | 90997 | 90933 | | | | | | | | | | 67 |
| 68 | 90350 | 90628 | 90541 | 90607 | | | | | | | | | | 68 |
| 69 | 90220 | 90304 | 90206 | 90040 | | | | | | | | | | 69 |
| 70 | 90413 | 90482 | 90407 | 90484 | | | | | | | | | | 70 |
| 71 | 90075 | 90039 | 90058 | 90126 | | | | | | | | | | 71 |
| 72 | 90242 | 90327 | 90234 | 90300 | | | | | | | | | | 72 |
| 73 | 90170 | 90233 | 90155 | 90189 | | | | | | | | | | 73 |
| 74 | 90550 | 90610 | 90563 | 90409 | | | | | | | | | | 74 |
| 75 | 90620 | 90691 | 90629 | 90673 | | | | | | | | | | 75 |
| 76 | 90374 | 90447 | 90381 | 90424 | | | | | | | | | | 76 |
| 77 | 90563 | 90628 | 90574 | 90630 | | | | | | | | | | 77 |
| 78 | 90811 | 90819 | 90831 | 90860 | | | | | | | | | | 78 |
| 79 | 90724 | 90793 | 90734 | 90765 | | | | | | | | | | 79 |
| 80 | 90357 | 90371 | 90262 | 90295 | | | | | | | | | | 80 |
| 81 | 90199 | 90266 | 90216 | 90263 | | | | | | | | | | 81 |
| 82 | 90127 | 90194 | 90163 | 90204 | | | | | | | | | | 82 |
| 83 | 90460 | 90543 | 90468 | 90519 | | | | | | | | | | 83 |
| 84 | 90360 | 90433 | 90405 | 90438 | | | | | | | | | | 84 |
| 85 | 90740 | 90784 | 90756 | 90765 | | | | | | | | | | 85 |
| 86 | 90269 | 90330 | 90267 | 90323 | | | | | | | | | | 86 |
| 87 | 90324 | 90319 | 90299 | 90341 | | | | | | | | | | 87 |
| 88 | 90573 | 90634 | 90590 | 90612 | | | | | | | | | | 88 |
| 89 | 90499 | 90561 | 90528 | 90569 | | | | | | | | | | 89 |
| 90 | 90562 | 90667 | 90627 | 90628 | | | | | | | | | | 90 |

Lot 13, Effective Resistance

| Sample Number | Initial Resistance | After Shock | After Vibration | After Low-Temp. | After Immersion | After Salt Spray | After Mols. Res. | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Storage 2000 hours | Storage 3000 hours | Storage 4000 hours | Storage 5000 hours | Sample Number |
|---------------|--------------------|-------------|-----------------|-----------------|-----------------|------------------|------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------|
| 31 | 4.0 | 3.5 | 3.5 | 4.0 | | | | | | | | | | | | | | 31 |
| 32 | 5.0 | 4.0 | 3.5 | 4.0 | | | | | | | | | | | | | | 32 |
| 33 | 5.0 | 4.0 | 3.0 | 4.0 | | | | | | | | | | | | | | 33 |
| 34 | 4.0 | 5.5 | 5.0 | 5.0 | | | | | | | | | | | | | | 34 |
| 35 | 4.0 | 3.5 | 3.0 | 5.0 | | | | | | | | | | | | | | 35 |
| 36 | 5.5 | 5.5 | 3.5 | 5.0 | | | | | | | | | | | | | | 36 |
| 37 | 5.0 | 5.5 | 4.0 | 5.0 | | | | | | | | | | | | | | 37 |
| 38 | 6.5 | 5.5 | 3.5 | 5.0 | | | | | | | | | | | | | | 38 |
| 39 | 5.5 | 5.0 | 3.5 | 5.0 | | | | | | | | | | | | | | 39 |
| 40 | 6.0 | 5.0 | 3.5 | 5.0 | | | | | | | | | | | | | | 40 |
| 41 | 5.0 | 5.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 41 |
| 42 | 7.5 | 6.0 | 5.0 | 6.0 | | | | | | | | | | | | | | 42 |
| 43 | 6.5 | 6.5 | 4.0 | 6.0 | | | | | | | | | | | | | | 43 |
| 44 | 5.0 | 4.0 | 3.5 | 3.5 | | | | | | | | | | | | | | 44 |
| 45 | 6.0 | 5.0 | 4.5 | 5.0 | | | | | | | | | | | | | | 45 |
| 46 | 6.5 | 5.0 | 4.5 | 6.0 | | | | | | | | | | | | | | 46 |
| 47 | 6.0 | 5.0 | 4.5 | 5.0 | | | | | | | | | | | | | | 47 |
| 48 | 6.0 | 5.0 | 4.5 | 5.0 | | | | | | | | | | | | | | 48 |
| 49 | 5.0 | 5.5 | 4.5 | 5.0 | | | | | | | | | | | | | | 49 |
| 50 | 5.0 | 5.5 | 4.5 | 5.0 | | | | | | | | | | | | | | 50 |
| 51 | 4.0 | 3.5 | 4.0 | 4.0 | | | | | | | | | | | | | | 51 |
| 52 | 5.0 | 4.0 | 4.0 | 5.0 | | | | | | | | | | | | | | 52 |
| 53 | 5.0 | 4.0 | 3.5 | 3.5 | | | | | | | | | | | | | | 53 |
| 54 | 4.0 | 3.5 | 3.0 | 4.0 | | | | | | | | | | | | | | 54 |
| 55 | 3.5 | 3.5 | 3.0 | 3.5 | | | | | | | | | | | | | | 55 |
| 56 | 4.0 | 3.5 | 3.0 | 4.0 | | | | | | | | | | | | | | 56 |
| 57 | 6.0 | 5.5 | 3.5 | 5.0 | | | | | | | | | | | | | | 57 |
| 58 | 4.0 | 4.5 | 3.5 | 4.0 | | | | | | | | | | | | | | 58 |
| 59 | 4.0 | 3.5 | 3.5 | 4.0 | | | | | | | | | | | | | | 59 |
| 60 | 4.0 | 3.5 | 4.0 | 4.0 | | | | | | | | | | | | | | 60 |

| Sample Number | Initial Frequency | After Shock | After Vibration | After Low-Temp. | After Immersion | After Salt Spray | After Mois. Res. | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Sample Number |
|---------------|-------------------|-------------|-----------------|-----------------|-----------------|------------------|------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|---------------|
| 1 | 97282 | 97240 | 97159 | 97270 | | | | | | | | | | 1 |
| 2 | 97400 | 97340 | 97347 | 97388 | | | | | | | | | | 2 |
| 3 | 97150 | 97100 | 97024 | 97101 | | | | | | | | | | 3 |
| 4 | 97123 | 97000 | 96951 | 97024 | | | | | | | | | | 4 |
| 5 | 97240 | 97220 | 97164 | 97234 | | | | | | | | | | 5 |
| 6 | 97445 | 97383 | 97319 | 97317 | | | | | | | | | | 6 |
| 7 | 97444 | 97359 | 97344 | 97368 | | | | | | | | | | 7 |
| 8 | 97290 | 97222 | 97130 | 97212 | | | | | | | | | | 8 |
| 9 | 97120 | 96919 | 96756 | 96738 | | | | | | | | | | 9 |
| 10 | 97255 | 97210 | 97137 | 97200 | | | | | | | | | | 10 |
| 11 | 96857 | 96590 | 96458 | 96448 | | | | | | | | | | 11 |
| 12 | 97074 | 97000 | 96837 | 96984 | | | | | | | | | | 12 |
| 13 | 97500 | 97447 | 97335 | 97422 | | | | | | | | | | 13 |
| 14 | 97256 | 97176 | 97114 | 97064 | | | | | | | | | | 14 |
| 15 | 97200 | 97132 | 97137 | 97166 | | | | | | | | | | 15 |
| 16 | 97361 | 97373 | 97316 | 97358 | | | | | | | | | | 16 |
| 17 | 97068 | 97020 | 96908 | 96980 | | | | | | | | | | 17 |
| 18 | 97376 | 97313 | 97236 | 97263 | | | | | | | | | | 18 |
| 19 | 97183 | 97101 | 96970 | 97081 | | | | | | | | | | 19 |
| 20 | 97086 | 96875 | 96659 | 96489 | | | | | | | | | | 20 |
| 21 | 97222 | 97160 | 97034 | 97030 | | | | | | | | | | 21 |
| 22 | 97160 | 97131 | 97062 | 97068 | | | | | | | | | | 22 |
| 23 | 97230 | 97020 | 96853 | 96965 | | | | | | | | | | 23 |
| 24 | 97356 | 97254 | 97186 | 97211 | | | | | | | | | | 24 |
| 25 | 97000 | * | | | | | | | | | | | | 25 |
| 26 | 97307 | 97265 | 97185 | 97166 | | | | | | | | | | 26 |
| 27 | 97013 | 96814 | 96673 | 96705 | | | | | | | | | | 27 |
| 28 | 97254 | 97050 | 96860 | 96800 | | | | | | | | | | 28 |
| 29 | 97256 | 97065 | 96887 | 96868 | | | | | | | | | | 29 |
| 30 | 97174 | 97128 | 97003 | 97075 | | | | | | | | | | 30 |

Lot 15, Series Resonant Frequency

| Sample Number | Initial Resistance | After Shock | After Vibration | After Low-Temp. | After Immersion | After Salt Spray | After Mols. Res. | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Storage 2000 hours | Storage 3000 hours | Storage 4000 hours | Storage 5000 hours | Sample Number |
|---------------|--------------------|-------------|-----------------|-----------------|-----------------|------------------|------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------|
| 1 | 22 | 21 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 1 |
| 2 | 20 | 20 | 21 | 20 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 2 |
| 3 | 18 | 17 | 19 | 19 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 3 |
| 4 | 20 | 19 | 20 | 21 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 4 |
| 5 | 20 | 18 | 18 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 5 |
| 6 | 32 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 6 |
| 7 | 36 | 18 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 7 |
| 8 | 42 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 8 |
| 9 | 16 | 15 | 15 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 9 |
| 10 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 10 |
| 11 | 17 | 17 | 17 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 11 |
| 12 | 17 | 15 | 15 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 12 |
| 13 | 91 | 20 | 20 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 13 |
| 14 | 21 | 20 | 20 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 14 |
| 15 | 23 | 21 | 21 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 15 |
| 16 | 25 | 24 | 25 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 16 |
| 17 | 21 | 19 | 20 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 17 |
| 18 | 26 | 24 | 25 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 18 |
| 19 | 18 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 |
| 20 | 21 | 21 | 22 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| 21 | 29 | 28 | 29 | 30 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 21 |
| 22 | 20 | 18 | 19 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 |
| 23 | 42 | 22 | 21 | 21 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 23 |
| 24 | 15 | * | 20 | 12 | 20 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 24 |
| 25 | 15 | * | 20 | 20 | 18 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 25 |
| 26 | 12 | 12 | 17 | 17 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 26 |
| 27 | 17 | 16 | 17 | 17 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 27 |
| 28 | 18 | 17 | 18 | 17 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 28 |
| 29 | 18 | 18 | 19 | 20 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 29 |
| 30 | 19 | 18 | 18 | 18 | 19 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 30 |

Lot 15, Effective Resistance

| Sample Number | Initial Frequency | After Shock | After Vibration | After Low-Temp. | After Immersion | After Salt Spray | After Mois. Res. | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Sample Number |
|---------------|-------------------|-------------|-----------------|-----------------|-----------------|------------------|------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|---------------|
| A1 | 97137 | 96999 | 96939 | 97026 | | | | | | | | | | A1 |
| A2 | 97261 | 97162 | 96956 | 97150 | | | | | | | | | | A2 |
| A3 | 97261 | 97162 | 97077 | 97134 | | | | | | | | | | A3 |
| A4 | 97438 | 97381 | 97184 | 97310 | | | | | | | | | | A4 |
| A5 | 97042 | 97010 | 96928 | 96945 | | | | | | | | | | A5 |
| A6 | 97474 | 97381 | 97271 | 97360 | | | | | | | | | | A6 |
| A7 | 97507 | 97347 | 97307 | 97408 | | | | | | | | | | A7 |
| A8 | 97285 | 97221 | 97167 | 97153 | | | | | | | | | | A8 |
| A9 | 97214 | 97179 | 97132 | 97180 | | | | | | | | | | A9 |
| A10 | 97258 | 97179 | 97123 | 97186 | | | | | | | | | | A10 |
| A11 | 97583 | 97472 | 97342 | 97370 | | | | | | | | | | A11 |
| A12 | 97300 | 97266 | 97200 | 97245 | | | | | | | | | | A12 |
| A13 | 97187 | 97134 | 97069 | 97093 | | | | | | | | | | A13 |
| A14 | 97310 | 97266 | 97159 | 97200 | | | | | | | | | | A14 |
| A15 | 97366 | 97472 | 97336 | 97379 | | | | | | | | | | A15 |
| A16 | 97384 | 97381 | 97289 | 97300 | | | | | | | | | | A16 |
| A17 | 97400 | 97300 | 97213 | 97300 | | | | | | | | | | A17 |
| A18 | 97322 | 97221 | 97168 | 97201 | | | | | | | | | | A18 |
| A19 | 97339 | 97300 | 97234 | 97298 | | | | | | | | | | A19 |
| A20 | 97409 | 97300 | 97315 | 97350 | | | | | | | | | | A20 |
| A21 | 97314 | 97200 | 97183 | 97229 | | | | | | | | | | A21 |
| A22 | 96888 | 96795 | 96705 | 96776 | | | | | | | | | | A22 |
| A23 | 96875 | 96733 | 96578 | 96730 | | | | | | | | | | A23 |
| A24 | 97370 | 97266 | 97230 | 97244 | | | | | | | | | | A24 |
| A25 | 97300 | 97179 | 97140 | 97128 | | | | | | | | | | A25 |
| A26 | 97150 | 97070 | 97019 | 96969 | | | | | | | | | | A26 |
| A27 | 97261 | 97251 | 97165 | 97146 | | | | | | | | | | A27 |
| A28 | 97515 | 97472 | 97442 | 97447 | | | | | | | | | | A28 |
| A29 | 97192 | 97134 | 97073 | 97030 | | | | | | | | | | A29 |
| A30 | 97125 | 96999 | 96845 | 96817 | | | | | | | | | | A30 |

Lot 16, Series Resonant Frequency

| Sample Number | Initial Resistance | After Shock | After Vibration | After Low-Temp. | After Immersion | After Salt Spray | After Mols. Res. | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Storage 2000 hours | Storage 3000 hours | Storage 4000 hours | Storage 5000 hours | Sample Number |
|---------------|--------------------|-------------|-----------------|-----------------|-----------------|------------------|------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------|
| A1 | 18 | 18 | 18 | 18 | 19 | 18 | | | | | | | | | | | | A1 |
| A2 | 25 | 24 | 24 | 25 | 25 | 25 | | | | | | | | | | | | A2 |
| A3 | 18 | 18 | 18 | 18 | 18 | 17 | | | | | | | | | | | | A3 |
| A4 | 21 | 20 | 21 | 21 | 21 | 20 | | | | | | | | | | | | A4 |
| A5 | 25 | 24 | 26 | 25 | 24 | 24 | | | | | | | | | | | | A5 |
| A6 | 19 | 20 | 22 | 22 | 19 | 18 | | | | | | | | | | | | A6 |
| A7 | 23 | 24 | 22 | 22 | 22 | 21 | | | | | | | | | | | | A7 |
| A8 | 20 | 20 | 20 | 22 | 22 | 19 | | | | | | | | | | | | A8 |
| A9 | 16 | 17 | 17 | 16 | 17 | 15 | | | | | | | | | | | | A9 |
| A10 | 17 | 17 | 18 | 17 | 18 | 17 | | | | | | | | | | | | A10 |
| A11 | 22 | 21 | 21 | 22 | 25 | 22 | | | | | | | | | | | | A11 |
| A12 | 20 | 19 | 19 | 18 | 19 | 18 | | | | | | | | | | | | A12 |
| A13 | 28 | 24 | 25 | 25 | 23 | 23 | | | | | | | | | | | | A13 |
| A14 | 18 | 18 | 19 | 18 | 18 | 18 | | | | | | | | | | | | A14 |
| A15 | 22 | 22 | 20 | 19 | 20 | 19 | | | | | | | | | | | | A15 |
| A16 | 18 | 18 | 18 | 18 | 18 | 17 | | | | | | | | | | | | A16 |
| A17 | 20 | 20 | 20 | 19 | 20 | 19 | | | | | | | | | | | | A17 |
| A18 | 17 | 16 | 16 | 16 | 17 | 16 | | | | | | | | | | | | A18 |
| A19 | 24 | 22 | 22 | 22 | 24 | 27 | | | | | | | | | | | | A19 |
| A20 | 25 | 25 | 25 | 25 | 25 | 25 | | | | | | | | | | | | A20 |
| A21 | 25 | 25 | 25 | 24 | 25 | 24 | | | | | | | | | | | | A21 |
| A22 | 39 | 37 | 40 | 36 | 34 | 35 | | | | | | | | | | | | A22 |
| A23 | 18 | 18 | 18 | 19 | 18 | 18 | | | | | | | | | | | | A23 |
| A24 | 18 | 17 | 18 | 17 | 18 | 17 | | | | | | | | | | | | A24 |
| A25 | 18 | 17 | 18 | 17 | 18 | 20 | | | | | | | | | | | | A25 |
| A26 | 22 | 22 | 22 | 22 | 21 | 18 | | | | | | | | | | | | A26 |
| A27 | 19 | 18 | 18 | 18 | 19 | 18 | | | | | | | | | | | | A27 |
| A28 | 24 | 24 | 24 | 23 | 24 | 22 | | | | | | | | | | | | A28 |
| A29 | 18 | 18 | 18 | 18 | 18 | 18 | | | | | | | | | | | | A29 |
| A30 | 22 | 21 | 21 | 21 | 24 | 22 | | | | | | | | | | | | A30 |

Lot 16, Effective Resistance

| Sample Number | Initial Frequency | After Shock | After Vibration | After Low-Temp. | After Immersion | After Salt Spray | After Mois. Res. | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Sample Number |
|---------------|-------------------|-------------|-----------------|-----------------|-----------------|------------------|------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|---------------|
| T1 | 97259 | 97240 | 97195 | 97189 | | | | | | | | | | T1 |
| T2 | 97274 | 97260 | 97205 | 97258 | | | | | | | | | | T2 |
| T3 | 97078 | 96960 | 96920 | 96934 | | | | | | | | | | T3 |
| T4 | 96923 | 96856 | 96790 | 96850 | | | | | | | | | | T4 |
| T5 | 97279 | 97200 | 97178 | 97213 | | | | | | | | | | T5 |
| T6 | 97200 | 97145 | 97087 | 97115 | | | | | | | | | | T6 |
| T7 | 97181 | 97100 | 97089 | 97084 | | | | | | | | | | T7 |
| T8 | 97143 | 97000 | 97023 | 97072 | | | | | | | | | | T8 |
| T9 | 97423 | 97347 | 97315 | 97354 | | | | | | | | | | T9 |
| T10 | 96840 | 96670 | 96530 | 96580 | | | | | | | | | | T10 |
| T11 | 97027 | 96960 | 96907 | 96969 | | | | | | | | | | T11 |
| T12 | 97200 | 97200 | 97159 | 97189 | | | | | | | | | | T12 |
| T13 | 97187 | 97070 | 97051 | 97097 | | | | | | | | | | T13 |
| T14 | 97543 | 97400 | 97418 | 97340 | | | | | | | | | | T14 |
| T15 | 97145 | 97070 | 97109 | 97111 | | | | | | | | | | T15 |
| T16 | 97110 | 96856 | 96674 | 96672 | | | | | | | | | | T16 |
| T17 | 97272 | 97200 | 97166 | 97216 | | | | | | | | | | T17 |
| T18 | 97335 | 97145 | 97206 | 97217 | | | | | | | | | | T18 |
| T19 | 97234 | 97100 | 97133 | 97060 | | | | | | | | | | T19 |
| T20 | 97248 | 97200 | 97175 | 97200 | | | | | | | | | | T20 |
| T21 | 97008 | 96960 | 96989 | 96929 | | | | | | | | | | T21 |
| T22 | 97100 | 97000 | 96976 | 97017 | | | | | | | | | | T22 |
| T23 | 97015 | 96900 | 96869 | 96900 | | | | | | | | | | T23 |
| T24 | 97464 | 97391 | 97353 | 97337 | | | | | | | | | | T24 |
| T25 | 97344 | 97260 | 97100 | 97200 | | | | | | | | | | T25 |
| T26 | 97393 | 97333 | 97265 | 97285 | | | | | | | | | | T26 |
| T27 | 97344 | 97145 | 97234 | 97222 | | | | | | | | | | T27 |
| T28 | 97093 | 96856 | 96717 | 96728 | | | | | | | | | | T28 |
| T29 | 97028 | 96960 | 96925 | 96875 | | | | | | | | | | T29 |
| T30 | 97440 | 97391 | 97300 | 97347 | | | | | | | | | | T30 |

Lot 17, Series Resonant Frequency

| Sample Number | Initial Resistance | After Shock | After Vibration | After Low-Temp. | After Immersion | After Salt Spray | After Mols. Res. | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Storage 2000 hours | Storage 3000 hours | Storage 4000 hours | Storage 5000 hours | Sample Number |
|---------------|--------------------|-------------|-----------------|-----------------|-----------------|------------------|------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------|
| T1 | 18 | 18 | 18 | 18 | 18 | 17 | | | | | | | | | | | | T1 |
| T2 | 18 | 19 | 19 | 18 | 19 | 20 | | | | | | | | | | | | T2 |
| T3 | 19 | 18 | 18 | 18 | 20 | 13 | | | | | | | | | | | | T3 |
| T4 | 30 | 30 | 30 | 30 | 30 | 30 | | | | | | | | | | | | T4 |
| T5 | 28 | 28 | 28 | 28 | 28 | 28 | | | | | | | | | | | | T5 |
| T6 | 19 | 19 | 20 | 19 | 20 | 19 | | | | | | | | | | | | T6 |
| T7 | 18 | 17 | 18 | 18 | 18 | 16 | | | | | | | | | | | | T7 |
| T8 | 26 | 27 | 26 | 25 | 25 | 24 | | | | | | | | | | | | T8 |
| T9 | 18 | 18 | 18 | 18 | 18 | 17 | | | | | | | | | | | | T9 |
| T10 | 17 | 16 | 18 | 18 | 18 | 16 | | | | | | | | | | | | T10 |
| T11 | 30 | 30 | 30 | 30 | 30 | 28 | | | | | | | | | | | | T11 |
| T12 | 16 | 16 | 16 | 16 | 16 | 20 | | | | | | | | | | | | T12 |
| T13 | 21 | 21 | 20 | 19 | 20 | 19 | | | | | | | | | | | | T13 |
| T14 | 25 | 24 | 25 | 22 | 22 | 21 | | | | | | | | | | | | T14 |
| T15 | 24 | 22 | 23 | 22 | 22 | 21 | | | | | | | | | | | | T15 |
| T16 | 17 | 17 | 17 | 18 | 18 | 17 | | | | | | | | | | | | T16 |
| T17 | 17 | 17 | 18 | 18 | 17 | 16 | | | | | | | | | | | | T17 |
| T18 | 19 | 18 | 19 | 18 | 19 | 18 | | | | | | | | | | | | T18 |
| T19 | 20 | 19 | 20 | 21 | 20 | 19 | | | | | | | | | | | | T19 |
| T20 | 22 | 21 | 21 | 22 | 21 | 21 | | | | | | | | | | | | T20 |
| T21 | 18 | 18 | 18 | 18 | 18 | 18 | | | | | | | | | | | | T21 |
| T22 | 17 | 17 | 17 | 17 | 17 | 16 | | | | | | | | | | | | T22 |
| T23 | 22 | 22 | 22 | 22 | 22 | 22 | | | | | | | | | | | | T23 |
| T24 | 28 | 27 | 27 | 27 | 28 | 27 | | | | | | | | | | | | T24 |
| T25 | 19 | 19 | 19 | 18 | 19 | 18 | | | | | | | | | | | | T25 |
| T26 | 30 | 28 | 30 | 30 | 30 | 28 | | | | | | | | | | | | T26 |
| T27 | 30 | 28 | 28 | 28 | 28 | 27 | | | | | | | | | | | | T27 |
| T28 | 24 | 24 | 25 | 22 | 25 | 24 | | | | | | | | | | | | T28 |
| T29 | 19 | 18 | 18 | 19 | 19 | 18 | | | | | | | | | | | | T29 |
| T30 | 20 | 24 | 20 | 19 | 20 | 19 | | | | | | | | | | | | T30 |

Lot 17, Effective Resistance

| Sample Number | Initial Frequency | After Shock | After Vibration | After Low-Temp. | After Immersion | After Salt Spray | After Mois. Res. | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Sample Number |
|---------------|-------------------|-------------|-----------------|-----------------|-----------------|------------------|------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|---------------|
| 1 | 97950 | | | | | | | | | | | | | 1 |
| 2 | 98000 | | | | | | | | | | | | | 2 |
| 3 | 97745 | | | | | | | | | | | | | 3 |
| 4 | 97855 | | | | | | | | | | | | | 4 |
| 5 | 97867 | | | | | | | | | | | | | 5 |
| 6 | 97927 | | | | | | | | | | | | | 6 |
| 7 | 98058 | | | | | | | | | | | | | 7 |
| 8 | 98212 | | | | | | | | | | | | | 8 |
| 9 | 97933 | | | | | | | | | | | | | 9 |
| 10 | 97943 | | | | | | | | | | | | | 10 |
| 11 | 97800 | | | | | | | | | | | | | 11 |
| 12 | 97715 | | | | | | | | | | | | | 12 |
| 13 | 97877 | | | | | | | | | | | | | 13 |
| 14 | 97703 | | | | | | | | | | | | | 14 |
| 15 | 97621 | | | | | | | | | | | | | 15 |
| 16 | 97814 | | | | | | | | | | | | | 16 |
| 17 | 97888 | | | | | | | | | | | | | 17 |
| 18 | 98100 | | | | | | | | | | | | | 18 |
| 19 | 97684 | | | | | | | | | | | | | 19 |
| 20 | 97952 | | | | | | | | | | | | | 20 |
| 21 | 98132 | | | | | | | | | | | | | 21 |
| 22 | 98035 | | | | | | | | | | | | | 22 |
| 23 | 98114 | | | | | | | | | | | | | 23 |
| 24 | 98068 | | | | | | | | | | | | | 24 |
| 25 | 97962 | | | | | | | | | | | | | 25 |
| 26 | 98000 | | | | | | | | | | | | | 26 |
| 27 | 97752 | | | | | | | | | | | | | 27 |
| 28 | 97700 | | | | | | | | | | | | | 28 |
| 29 | 97976 | | | | | | | | | | | | | 29 |
| 30 | 98057 | | | | | | | | | | | | | 30 |

Lot 20, Series Resonant Frequency

| | | | | | | | | | | | | | | | | | | | |
|---------------|----|--------------------|-------------|-----------------|-----------------|-----------------|------------------|------------------|-------------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------|
| Sample Number | 06 | Initial Resistance | After Shock | After Vibration | After Low-Temp. | After Immersion | After Salt Spray | After Mols. Res. | After Aging | Storage 24 hours | Storage 125 hours | Storage 225 hours | Storage 500 hours | Storage 1000 hours | Storage 2000 hours | Storage 3000 hours | Storage 4000 hours | Storage 5000 hours | Sample Number |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 1 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 2 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 3 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 4 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 5 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 6 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 7 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 8 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 9 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 10 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 11 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 12 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 13 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 14 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 15 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 16 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 17 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 18 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 19 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 20 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 21 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 22 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 23 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 24 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 25 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 26 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 27 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 28 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 29 |
| 06 | 22 | 22 | | | | | | | | | | | | | | | | | 30 |

Lot 20, Effective Resistance

GENERAL DATA SHEET

| | | | | | | | |
|--------------------------------------------------|--|-------------------|--|------------|--|------------------------------|--|
| TEST Capacitance, Shunt | | SPEC: MIL-C-3098C | | PAR: 4.7.3 | | TEST NO: | |
| CONDITIONING: Room ambient | | | | | | DATE: | |
| MATERIAL: Crystal Unit, Quartz, Type CR-18A/U | | | | | | TEMP: RH: | |
| MANUFACTURER: "A" | | | | | | M. NO: | |
| INSTRUMENTS: Lots Number 1 and Number 2 | | | | | | TESTED BY: D. Switzer | |
| | | | | | | LAB SUP CHECK: H. Barrett | |
| | | | | | | ENGRG CHECK: C. F. J. 22 | |

| Sample Number | Capacitance, Pin-to-Pin, Picofarads | Sample Number | Capacitance Pin-to-Pin Picofarads | Sample Number | Capacitance Pin-to-Pin Picofarads |
|-------------------------------------------------------------------------------------------|-------------------------------------|---------------|-----------------------------------|---------------|-----------------------------------|
| 1 | 5.3 | 21 | 5.4 | 41 | 5.3 |
| 2 | 5.7 | 22 | 5.3 | 42 | 5.4 |
| 3 | 5.2 | 23 | 5.0 | 43 | 5.6 |
| 4 | 5.6 | 24 | 5.4 | 44 | 5.6 |
| 5 | 5.4 | 25 | 5.3 | 45 | 5.6 |
| 6 | 5.4 | 26 | 5.3 | 46 | 5.4 |
| 7 | 5.4 | 27 | 5.7 | 47 | 5.3 |
| 8 | 5.3 | 28 | 5.3 | 48 | 5.3 |
| 9 | 5.3 | 29 | 5.3 | 49 | 5.3 |
| 10 | 5.3 | 30 | 5.6 | 50 | 5.3 |
| 11 | 5.3 | 31 | 5.4 | 51 | 5.4 |
| 12 | 5.4 | 32 | 5.2 | 52 | 5.6 |
| 13 | 5.0 | 33 | 5.1 | 53 | 5.7 |
| 14 | 5.3 | 34 | 5.5 | 54 | 5.4 |
| 15 | 5.2 | 35 | 5.4 | 55 | 5.4 |
| 16 | 5.4 | 36 | 5.4 | 56 | 5.2 |
| 17 | 5.4 | 37 | 5.3 | 57 | 5.2 |
| 18 | 5.5 | 38 | 5.2 | 58 | 5.3 |
| 19 | 5.6 | 39 | 5.1 | 59 | 5.1 |
| 20 | 5.3 | 40 | 5.4 | 60 | 5.3 |
| | | | | | |
| Required: The shunt capacitance of the crystal units shall not exceed 7.0 pf. pin-to-pin. | | | | | |
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GENERAL DATA SHEET

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|--------------------------------------------------|-----------------------|---------------|------------------------------|
| TEST Capacitance, Shunt | SPEC: MIL-C- 3098C | PAR: 4.7.3 | TEST NO: |
| CONDITIONING: Room ambient | | | DATE: |
| MATERIAL: Crystal Unit, Quartz, Type CR-18A/U | | | TEMP: RH: |
| MANUFACTURER: "A" | | | M. NO: |
| INSTRUMENTS: Lots Number 3 and Number 4 | | | TESTED BY: D. Switzer |
| | | | LAB SUP CHECK: H. Barrett |
| | | | ENGRG CHECK: C. E. Jones |
| | | | |

| Sample Number | Capacitance Pin-to-Pin Picofarads | Sample Number | Capacitance Pin-to-Pin Picofarads | Sample Number | Capacitance Pin-to-Pin Picofarads |
|-------------------------------------------------------------------------------------------|-----------------------------------|---------------|-----------------------------------|---------------|-----------------------------------|
| 61 | 5.5 | 81 | 5.5 | 101 | 5.5 |
| 62 | 5.3 | 82 | 5.3 | 102 | 5.6 |
| 63 | 5.3 | 83 | 5.4 | 103 | 5.3 |
| 64 | 5.5 | 84 | 5.4 | 104 | 5.1 |
| 65 | 5.4 | 85 | 5.4 | 105 | 5.4 |
| 66 | 5.3 | 86 | 5.5 | 106 | 5.1 |
| 67 | 5.6 | 87 | 5.4 | 107 | 5.2 |
| 68 | 5.6 | 88 | 5.0 | 108 | 5.2 |
| 69 | 5.6 | 89 | 5.3 | 109 | 5.1 |
| 70 | 5.7 | 90 | 5.4 | 110 | 5.3 |
| 71 | 5.7 | 91 | 5.7 | 111 | 5.4 |
| 72 | 5.6 | 92 | 5.3 | 112 | 5.3 |
| 73 | 5.3 | 93 | 5.6 | 113 | 5.3 |
| 74 | 5.4 | 94 | 5.4 | 114 | 5.4 |
| 75 | 5.2 | 95 | 5.5 | 115 | 5.4 |
| 76 | 5.3 | 96 | 5.3 | 116 | 5.3 |
| 77 | 5.4 | 97 | 5.2 | 117 | 5.3 |
| 78 | 5.2 | 98 | 5.4 | 118 | 5.3 |
| 79 | 5.1 | 99 | 5.5 | 119 | 5.4 |
| 80 | 5.5 | 100 | 5.6 | 120 | 5.2 |
| Required: The shunt capacitance of the crystal units shall not exceed 7.0 pf, pin-to-pin. | | | | | |
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GENERAL DATA SHEET

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|-------------------------------------------------|-----------------------|---------------|------------------------------------------|
| TEST Capacitance, Shunt | SPEC: MIL-C- 3098C | PAR: 4.7.3 | TEST NO: |
| CONDITIONING: Room ambient | | | DATE: |
| MATERIAL: Crystal Unit, Quartz, Type CR-67/U | | | TEMP: RH: |
| MANUFACTURER: "A" | | | M. NO: |
| INSTRUMENTS: Lots Number 5 and Number 6 | | | TESTED BY: D. Switzer |
| | | | LAB SUP CHECK: H. Barrett |
| | | | ENGRG CHECK: C. E. <i>[Signature]</i> |

| Sample Number | Capacitance Pin-to-Pin PicoFarads | Sample Number | Capacitance Pin-to-Pin PicoFarads | Sample Number | Capacitance Pin-to-Pin PicoFarads |
|-------------------------------------------------------------------------------------------|-----------------------------------|---------------|-----------------------------------|---------------|-----------------------------------|
| 1 | 5.5 | 21 | 6.4 | A11 | 5.4 |
| 2 | 5.4 | 22 | 6.5 | A12 | 5.4 |
| 3 | 5.5 | 23 | 6.4 | A13 | 5.5 |
| 4 | 5.6 | 24 | 6.5 | A14 | 5.4 |
| 5 | 5.5 | 25 | 6.5 | A15 | 5.6 |
| 6 | 5.6 | 26 | 6.6 | A16 | 5.3 |
| 7 | 5.5 | 27 | 6.4 | A17 | 5.3 |
| 8 | 5.4 | 28 | 6.6 | A18 | 5.6 |
| 9 | 5.6 | 29 | 6.4 | A19 | 5.5 |
| 10 | 5.8 | 30 | 6.4 | A20 | 5.6 |
| 11 | 5.8 | A1 | 5.4 | A21 | 5.5 |
| 12 | 5.7 | A2 | 5.4 | A22 | 5.4 |
| 13 | 5.6 | A3 | 5.5 | A23 | 5.3 |
| 14 | 5.9 | A4 | 5.5 | A24 | 5.5 |
| 15 | 5.5 | A5 | 5.5 | A25 | 5.4 |
| 16 | 5.6 | A6 | 5.4 | A26 | 5.7 |
| 17 | 5.7 | A7 | 5.3 | A27 | 5.9 |
| 18 | 5.6 | A8 | 5.3 | A28 | 5.6 |
| 19 | 6.6 | A9 | 5.7 | A29 | 5.7 |
| 20 | 6.3 | A10 | 5.5 | A30 | 5.6 |
| | | | | | |
| Required: The shunt capacitance of the crystal units shall not exceed 7.0 pf, pin-to-pin. | | | | | |
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GENERAL DATA SHEET

| | | | |
|-------------------------------------|--------------|-------|----------------|
| TEST | SPEC: MIL-C- | PAR: | TEST NO: |
| Capacitance, Shunt | 3098C | 4.7.3 | |
| CONDITIONING: | | | DATE: |
| Room ambient | | | |
| MATERIAL: | | | TEMP: RH: |
| Crystal Unit, Quartz, Type CR-32A/U | | | |
| MANUFACTURER: | | | M. NO: |
| "A" | | | |
| INSTRUMENTS: | | | TESTED BY: |
| | | | D. Switzer |
| Lot Number 9 | | | LAB SUP CHECK: |
| | | | H. Barrett |
| | | | ENGRG CHECK: |
| | | | |

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GENERAL DATA SHEET

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|--------------------------------------------------|--|-----------------------|---------------|------------------------------|--|
| TEST Capacitance, Shunt | | SPEC: MIL-C- 3098C | PAR: 4.7.3 | TEST NO: | |
| CONDITIONING: Room ambient | | | | DATE: | |
| MATERIAL: Crystal Unit, Quartz, Type CR-18A/U | | | | TEMP: RH: | |
| MANUFACTURER: "B" | | | | M. NO: | |
| INSTRUMENTS: Lot Number 11 and 12 | | | | TESTED BY: D. Switzer | |
| | | | | LAB SUP CHECK: H. Barrett | |
| | | | | ENGRG CHECK: | |
| | | | | | |

| Sample Number | Capacitance Pin-to-Pin PicoFarads | Sample Number | Capacitance Pin-to-Pin PicoFarads | Sample Number | Capacitance Pin-to-Pin PicoFarads |
|-------------------------------------------------------------------------------------------|-----------------------------------|---------------|-----------------------------------|---------------|-----------------------------------|
| 1 | 5.8 | 21 | 5.9 | 41 | 6.0 |
| 2 | 5.7 | 22 | 5.8 | 42 | 5.8 |
| 3 | 5.8 | 23 | 5.8 | 43 | 5.9 |
| 4 | 5.8 | 24 | 5.8 | 44 | 5.8 |
| 5 | 5.8 | 25 | 5.8 | 45 | 5.8 |
| 6 | 5.7 | 26 | 5.8 | 46 | 5.7 |
| 7 | 5.7 | 27 | 5.9 | 47 | 5.7 |
| 8 | 5.8 | 28 | 5.8 | 48 | 5.8 |
| 9 | 5.8 | 29 | 5.9 | 49 | 5.9 |
| 10 | 5.8 | 30 | 5.8 | 50 | 5.9 |
| 11 | 5.7 | 31 | 5.7 | 51 | 5.9 |
| 12 | 5.7 | 32 | 5.8 | 52 | 5.9 |
| 13 | 5.7 | 33 | 5.8 | 53 | 5.8 |
| 14 | 5.8 | 34 | 5.9 | 54 | 5.9 |
| 15 | 5.7 | 35 | 5.8 | 55 | 5.8 |
| 16 | 5.8 | 36 | 5.9 | 56 | 6.0 |
| 17 | 5.8 | 37 | 5.9 | 57 | 5.9 |
| 18 | 5.8 | 38 | 5.7 | 58 | 6.0 |
| 19 | 5.9 | 39 | 6.0 | 59 | 6.0 |
| 20 | 5.9 | 40 | 5.9 | 60 | 6.0 |
| | | | | | |
| Required: The shunt capacitance of the crystal units shall not exceed 7.0 pf, pin-to-pin. | | | | | |
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GENERAL DATA SHEET

[illegible]

GENERAL DATA SHEET

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|--------------------------------------------------|--|-----------------------|--|------------|--|----------------------------------|--|
| TEST Capacitance, Shunt | | SPEC: MIL-C- 3098C | | PAR: 4.7.3 | | TEST NO: | |
| CONDITIONING: Room ambient | | | | | | DATE: | |
| MATERIAL: Crystal Unit, Quartz, Type CR-67/U | | | | | | TEMP: RH: | |
| MANUFACTURER: "B" | | | | | | M. NO: | |
| INSTRUMENTS: Lots Number 15 and Number 16 | | | | | | TESTED BY: D. Switzer | |
| | | | | | | LAB SUP CHECK: H. Barrett | |
| | | | | | | ENGRG CHECK: <i>C.E. Jara</i> | |
| | | | | | | | |

| Sample Number | Capacitance Pin-to-Pin PicoFarads | Sample Number | Capacitance Pin-to-Pin PicoFarads | Sample Number | Capacitance Pin-to-Pin PicoFarads |
|-------------------------------------------------------------------------------------------|-----------------------------------|---------------|-----------------------------------|---------------|-----------------------------------|
| 1 | 4.4 | 21 | 4.4 | A11 | 4.5 |
| 2 | 4.5 | 22 | 4.6 | A12 | 4.5 |
| 3 | 4.5 | 23 | 4.4 | A13 | 4.5 |
| 4 | 4.5 | 24 | 4.4 | A14 | 4.5 |
| 5 | 4.4 | 25 | 4.6 | A15 | 4.4 |
| 6 | 4.4 | 26 | 4.4 | A16 | 4.4 |
| 7 | 4.5 | 27 | 4.5 | A17 | 4.6 |
| 8 | 4.5 | 28 | 4.4 | A18 | 4.5 |
| 9 | 4.4 | 29 | 4.4 | A19 | 4.5 |
| 10 | 4.5 | 30 | 4.4 | A20 | 4.5 |
| 11 | 4.4 | A1 | 4.4 | A21 | 4.4 |
| 12 | 4.4 | A2 | 4.4 | A22 | 4.5 |
| 13 | 4.5 | A3 | 4.5 | A23 | 4.4 |
| 14 | 4.4 | A4 | 4.4 | A24 | 4.5 |
| 15 | 4.5 | A5 | 4.5 | A25 | 4.5 |
| 16 | 4.6 | A6 | 4.4 | A26 | 4.5 |
| 17 | 4.4 | A7 | 4.6 | A27 | 4.6 |
| 18 | 4.5 | A8 | 4.5 | A28 | 4.4 |
| 19 | 4.4 | A9 | 4.4 | A29 | 4.6 |
| 20 | 4.4 | A10 | 4.4 | A30 | 4.4 |
| Required: The shunt capacitance of the crystal units shall not exceed 7.0 pf, pin-to-pin. | | | | | |
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GENERAL DATA SHEET

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|---------------------------------------------------------|------------------------------------------|---------------------------------------------------------------------------------|------------------------------------------|----------------------|------------------------------------------|-------------------------------------|--|
| TEST Capacitance, Shunt | | SPEC: MIL-C-3098C | | PAR: 4.7.3 | | TEST NO: | |
| CONDITIONING: Room Ambient | | | | | | DATE: | |
| MATERIAL: Crystal Unit, Quartz, Type CR-67/U | | | | | | TEMP: RH: | |
| MANUFACTURER: "B" | | | | | | M. NO: | |
| INSTRUMENTS: Lots Number 17 and Number 18 | | | | | | TESTED BY: D. Switzer | |
| | | | | | | LAB SUP CHECK: H. Barrett | |
| | | | | | | ENGRG CHECK: C.E. Jones | |
| | | | | | | | |
| Sample Number | Capacitance Pin-to-Pin PicoFarads | Sample Number | Capacitance Pin-to-Pin PicoFarads | Sample Number | Capacitance Pin-to-Pin PicoFarads | | |
| T1 | 4.5 | T21 | 4.4 | L11 | | | |
| T2 | 4.5 | T22 | 4.5 | L12 | | | |
| T3 | 4.6 | T23 | 4.6 | L13 | | | |
| T4 | 4.4 | T24 | 4.5 | L14 | | | |
| T5 | 4.4 | T25 | 4.5 | L15 | | | |
| T6 | 4.6 | T26 | 4.6 | L16 | | | |
| T7 | 4.5 | T27 | 4.4 | L17 | | | |
| T8 | 4.5 | T28 | 4.4 | L18 | | | |
| T9 | 4.5 | T29 | 4.4 | L19 | | | |
| T10 | 4.6 | T30 | 4.4 | L20 | | | |
| T11 | 4.6 | L1 | | L21 | | | |
| T12 | 4.6 | L2 | | L22 | | | |
| T13 | 4.6 | L3 | | L23 | | | |
| T14 | 4.6 | L4 | | L24 | | | |
| T15 | 4.6 | L5 | | L25 | | | |
| T16 | 4.6 | L6 | | L26 | | | |
| T17 | 4.5 | L7 | | L27 | | | |
| T18 | 4.5 | L8 | | L28 | | | |
| T19 | 4.6 | L9 | | L29 | | | |
| T20 | 4.5 | L10 | | L30 | | | |
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| Required: | | The shunt capacitance of the crystal units shall not exceed 7.0 pf, pin-to-pin. | | | | | |
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ENGRG CHECK:
C. E. Jans

[illegible]

Conclusions

Since only a small percentage of the sample crystals are in the storage portion of this program, and these have been in storage for only a relatively short period of time, not enough data has yet been accumulated that any useful evaluation and analysis can be performed. When the next Quarterly Report is prepared, there will be sufficient information recorded that a meaningful review and analysis can be made, and some conclusions drawn concerning the objectives of this study.

Program for the Next Interval

During the next report period, preproduction testing of all crystals required for this program will be concluded, and all the crystals will be in Phase II testing. The data presently on hand and the data accruing during the next period will be analyzed to determine if any particular factors that produce failures of quartz crystals can be identified and explained.

Identification of Personnel

During the period covered by this report, two people have been directly assigned to this contract. These are the Project Engineer, Mr. Carleton E. Jones, and a technician, Mr. Dixon Switzer. A description of their backgrounds was included in the First Quarterly Report.

A second engineer, Mr. Robert Pease, also worked on this contract during this report period, designing the printed circuit oscillators used for the program, and supervising the fabrication and initial operation of the oscillator boards.

Through the end of this report period, Mr. Jones has performed approximately 850 man-hours of work on this contract, Mr. Pease 470 man-hours, and Mr. Switzer 690 man-hours.

A brief description of the background of Mr. Pease is given below.

PEASE, ROBERT W. - Engineer

Years Actively Engaged in Profession - 24 Years

Academic Training

Ohio State University

1931-1936

Employment Record

| <u>Dates</u> | <u>Company</u> | <u>Duties</u> |
|----------------|--------------------------------|--------------------|
| 1960 - Present | Inland Testing Laboratories | Engineer |
| 1958 - 1960 | Jackson Electrical Instr. Co. | Engineer |
| 1957 - 1958 | Production Control Units, Inc. | Engineer |
| 1954 - 1957 | Frigidaire Div. G.M.C. | Process Engineer |
| 1953 - 1954 | Acro Mfg. Co. | Project Engineer |
| 1939 - 1953 | Ranco Inc. | Asst. Dir. of Lab. |
| 1936 - 1938 | Battelle Memorial Institute | Lab. Technician |

Professional Experience

Inland Testing Laboratories - Engineer

Engaged in the designing of test fixtures and circuits; supervise technicians in the performance of electrical and environmental tests; prepare test procedures and reports.

Supervised test programs on aircraft transceivers; rescue transmitters; alarm receivers; oscilloscopes; Signal Corps transmitters and receivers; R.F. broad band transformers; crystal test circuits and fixtures.

Jackson Electrical Instrument Co. - Engineer

Engaged in design of electronic circuits and instruments.

Designed transistorized marine depth sounder and detergent mixture detector for commercial dish washers.

Production Control Units, inc.

Engaged in design of special equipment.

Designed electrical circuits and requisitioned parts for automatic vacuum alarm and dehydration equipment for hermetically sealed refrigeration compressors.

Frigidaire Division, General Motors Corp. - Process Engineer

Responsible for design and construction supervision of process tools and equipment for use in manufacturer of motor starting relays. This included automatic control circuits and automated assembly and inspection. Also responsible for plant layout for this department.

Acro Manufacturing Co. - Project Engineer

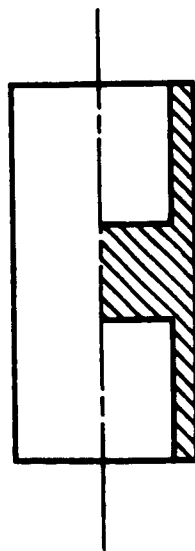
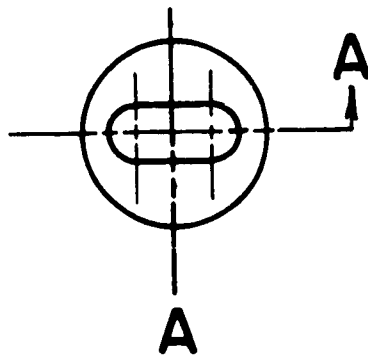
Responsible for design of spring forming machine and water level control for automatic home washers and dish washers.

Ranco, Inc. - Asst. Director of Laboratory

Responsible for supervision of laboratory technicians during absence of Director. Designed and supervised construction of laboratory test equipment and production assembly and test equipment.

Battelle Memorial Institute - Lab. Technician

Performed tests necessary in study of the corrosion of various steel alloys.



SECTION A-A

FIGURE 1.

Second Quarterly Progress Report, Contract DA 36-039 SC-89199

Distribution List

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| OASD (R&E), Room 3E1065 ATTN: Technical Library The Pentagon Washington 25, D.C. | 1 | Commanding Officer U.S. Army Signal Material Support Agency ATTN: SIGMS/ADJ Fort Monmouth, New Jersey | 1 |
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| Director U.S. Naval Research Laboratory ATTN: Code 2027 Washington 25, D.C. | 1 | Commander Armed Services Technical Information Agency ATTN: TIPCR Arlington Hall Station Arlington 12, Virginia | 10 |
| Commanding Officer & Director U.S. Navy Electronics Laboratory San Diego 52, California | 1 | National Bureau of Standards Boulder Laboratories Boulder, Colorado ATTN: Mr. W. D. George | 1 |
| Chief, Bureau of Ships, Code 690B Department of the Navy ATTN: Mr. R. B. McDowell Washington 25, D.C. | 1 | Commander Air Force Cambridge Research Laboratories ATTN: CRXL-R L. G. Hanscom Field Bedford, Massachusetts | 1 |
| ASD (ASENGE-3) ATTN: Mr. C. W. Friend Wright-Patterson Air Force Base, Ohio | 1 | Commander Air Force Command & Control Development Div. ATTN: CRZC L. G. Hanscom Field Bedford, Massachusetts | 1 |
| Commander Aeronautical Systems Division ATTN: ASNPVE-2, Mr. E. Borgelt Wright-Patterson AFB, Ohio | 1 | Commander Air Force Command & Control Development Div. ATTN: CCRR & CCSD L. G. Hanscom Field Bedford, Massachusetts | 2 |
| Commander Rome Air Development Center ATTN: RAALD Griffiss AFB, New York | 1 | AFSC Liaison Officer Naval Air R&D Activities Command Johnsville, Pennsylvania | 1 |

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| ATTN: SELRA/SL-DE | 1 | Frontier Electronics Company 4600 Memphis Avenue Cleveland, Ohio | |
| ATTN: SELRA/SL-ADT | 1 | ATTN: Mr. P. Lannan | 1 |
| ATTN: SELRA/SL-PF, Technical Staff (Record Copy) | 1 | General Electric Company Communications Products Department Mountain View Road Lynchburg, Virginia | |
| ATTN: SELRA/SL-TM | 3 | ATTN: Mr. John Sherman | 1 |
| ATTN: SELRA/SL-PF, Dr. E. A. Gerber | 1 | Keystone Electronics Company 65 - 7th Avenue Newark, New Jersey | |
| ATTN: SELRA/SL-PFP, Miss A. Herberg | 3 | ATTN: Mr. J. Ronan | 1 |
| ATTN: SELRA/SL-PFP, Mrs. S. Musgrave | 1 | The James Knights Company 131 South Wells Street Sandwich, Illinois | 1 |
| Dr. Virgil E. Bottom McMurray College Abilene, Texas | 1 | The Magnavox Company Government & Industrial Division 4501 Bueter Road Fort Wayne, Indiana | |
| Mr. Roger A. Sykes Bell Telephone Laboratories, Inc. Merrimack Valley No. Andover, Massachusetts | 1 | ATTN: Mr. Donald Firth | 1 |
| Commanding General U.S. Army Signal Supply Agency ATTN: Mr. E. Mason 225 South Eighteenth Street Philadelphia 3, Pennsylvania | 1 | McCoy Electronics Company Mt. Holly Springs, Pennsylvania ATTN: Mr. L. McCoy | 1 |
| Motorola, Inc. Communications Division 1450 North Cicero Avenue Chicago 51, Illinois | | Midland Mfg. Company 3155 Fiberglas Road Kansas City, Kansas | 1 |
| ATTN: Mr. C. F. Collins | 1 | Pioneer Central Division of Bendix Corporation Davenport, Iowa ATTN: Dr. D. E. Newell | 1 |

Second Quarterly Progress Report, Contract DA 36-039 SC-89199

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| Reeves-Hoffman Corporation 145 Cherry Street Carlisle, Pennsylvania ATTN: Mr. R. Van Gavree | 1 | Scientific Radio Products, Inc. 2303 West 8th Street Loveland, Colorado | 1 |
| Systems, Incorporated 2400 Diversified Way P.O. Box 7726 Orlando, Florida | 1 | Victor Electronic Systems Co. Division of Victor Comptometer Corp. 5600 Jarvis Avenue Chicago 48, Illinois ATTN: Mr. R. P. Chalker | 1 |

This contract is supervised by the Solid State & Frequency Control Division, Electronic Components Department, USASRDL, Fort Monmouth, New Jersey. For further technical information, contact the Project Engineer, Mr. P. E. Mulvihill, Telephone: 535-2475.

| | | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>AD _____ Accession No. _____ Cook Electric Company, Inland Testing Laboratories Division Dayton, Ohio</p> <p>QUARTZ CRYSTAL RELIABILITY STUDIES, Carleton E. Jones</p> <p>Report No. 2, 5 July 1962 to 5 October 1962, 67 pp., Signal Corps Contract DA 36-039 SC-89199, Unclassified Report</p> <p>Preliminary testing of crystals for use in reliability study, at initial stage of reliability study, are reported.</p> <p>Included are preproduction test data on 20 megacycle and 50 megacycle crystals manufactured in accordance with the provisions of Specification MIL-C-3098C.</p> | <p>AD _____ Accession No. _____ Cook Electric Company, Inland Testing Laboratories Division Dayton, Ohio</p> <p>QUARTZ CRYSTAL RELIABILITY STUDIES, Carleton E. Jones</p> <p>Report No. 2, 5 July 1962 to 5 October 1962, 67 pp., Signal Corps Contract DA 36-039 SC-89199, Unclassified Report</p> <p>Preliminary testing of crystals for use in reliability study, and initial stage of reliability study, are reported.</p> <p>Included are preproduction test data on 20 megacycle and 50 megacycle crystals manufactured in accordance with the provisions of Specification MIL-C-3098C.</p> | <p>UNCLASSIFIED</p> <p>1. Development of failure data during life testing of representative military type quartz crystal units.</p> <p>2. Signal Corps Contract No. DA 36-039 SC-89199</p> |
| <p>AD _____ Accession No. _____ Cook Electric Company, Inland Testing Laboratories Division Dayton, Ohio</p> <p>QUARTZ CRYSTAL RELIABILITY STUDIES, Carleton E. Jones</p> <p>Report No. 2, 5 July 1962 to 5 October 1962, 67 pp., Signal Corps Contract DA 36-039 SC-89199, Unclassified Report</p> <p>Preliminary testing of crystals for use in reliability study, and initial stage of reliability study, are reported.</p> <p>Included are preproduction test data on 20 megacycle and 50 megacycle crystals manufactured in accordance with the provisions of Specification MIL-C-3098C.</p> | <p>AD _____ Accession No. _____ Cook Electric Company, Inland Testing Laboratories Division Dayton, Ohio</p> <p>QUARTZ CRYSTAL RELIABILITY STUDIES, Carleton E. Jones</p> <p>Report No. 2, 5 July 1962 to 5 October 1962, 67 pp., Signal Corps Contract DA 36-039 SC-89199, Unclassified Report</p> <p>Preliminary testing of crystals for use in reliability study, and initial stage of reliability study, are reported.</p> <p>Included are preproduction test data on 20 megacycle and 50 megacycle crystals manufactured in accordance with the provisions of Specification MIL-C-3098C.</p> | <p>UNCLASSIFIED</p> <p>1. Development of failure data during life testing of representative military type quartz crystal units.</p> <p>2. Signal Corps Contract No. DA 36-039 SC-89199</p> |